YEARLY SUBSCRIPTION $6.00 SINGLE NUMBERS $1.00

DENTAL LIB.
JAN 10 1922

[FOUNDED IN 1906 AS THE AMERICAN QUARTERLY OF ROENTGENOLOGY]

THE AMERICAN JOURNAL OF ROENTGENOLOGY

OFFICIAL ORGAN OF
THE AMERICAN ROENTGEN RAY SOCIETY
AND THE AMERICAN RADIUM SOCIETY

EDITOR

H. M. IMBODEN, M.D. - - - - NEW YORK

ASSOCIATE EDITOR

PERCY BROWN, M.D. - - - - - BOSTON

EDITORIAL BOARD

FREDERICK H. BAETJER, M.D. - - Baltimore
A. BÉCLÈRE, M.D. - - - - Paris
DAVID R. BOWEN, M.D. - - Philadelphia
R. D. CARMAN, M.D. - - Rochester, Minn.
JAMES T. CASE, M.D. - - - Battle Creek
A. W. CRANE, M.D. - - - Kalamazoo
A. W. GEORGE, M.D. - - - - Boston
PRESTON M. HICKEY, M.D. - - - Detroit
ROBERT KNOX, M.D. - - - - London
R. LEDOUX-LEBARD, M.D. - - - - Paris
G. E. PFAHLER, M.D. - - - Philadelphia
J. S. SHEARER, PH.D. - - - - Ithaca
E. H. SKINNER, M.D. - - Kansas City, Mo.

PROPERTY OF DENTAL LIBRARY UNIVERSITY OF MICHIGAN DON'T MUTILATE OR REMOVE

VOLUME VIII NUMBER 12

December, 1921

PUBLISHED MONTHLY BY PAUL B. HOEBER
NEW YORK CITY

THIRD ANNUAL MEETING EASTERN SECTION AMERICAN ROENTGEN RAY SOCIETY, RITZ-CARLTON HOTEL, ATLANTIC CITY, N. J., JANUARY 26, 27, 28, 1922.

Entered as second-class matter, March 3, 1916, at the Post Office, New York, N. Y., under the Act of March 3, 1879.

Name .....

Street .....

City .....

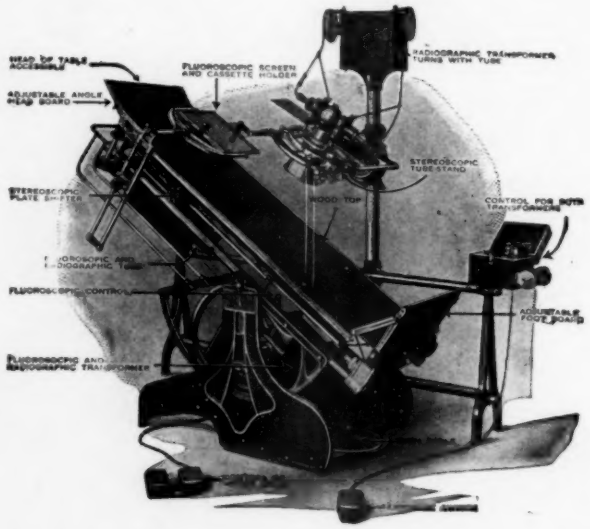
State .....

A.
J.
R.

Send Coupon for Catalog giving complete description and a Campbell X-Ray Exposure Scale, Free

Clinix X-Ray Plant

Contrast its Appearance with that of the Old-Style X-Ray Laboratory



The CLINIX is a complete X-Ray plant.

It operates at all angles.

It is the "Aristocrat" of the X-Ray Laboratory.

You owe it to yourself and to your hospital to investigate.

Campbell Electric Co.
Lynn, Mass

U. S. Patents December 19, 1911. April 22, 1913. February 29, 1916. August 7, 1917.
Also patented in foreign countries. Other patents pending. Infringers will be prosecuted.

THE AMERICAN JOURNAL OF ROENTGENOLOGY

Editor, H. M. Imboden, M.D., New York

VOL. VIII (NEW SERIES) DECEMBER, 1921. No. 12

BENIGN AND MALIGNANT GASTRIC ULCERS FROM A ROENTGENOLOGIC VIEWPOINT*

By RUSSELL D. CARMAN, M.D.

Section on Roentgenology, Mayo Clinic

ROCHESTER, MINNESOTA

NOTWITHSTANDING the high efficiency of the roentgen ray in the diagnosis of gastric cancer and gastric ulcer, I have at various times pointed out that the roentgen-ray examination does not always determine the benignancy or malignancy of a given ulcerous lesion. As exceptions to this view have occasionally been expressed I believe that a broader discussion of the subject may contribute to still greater concord of opinion.

Roentgenologic distinction between typical cancer and typical ulcer is manifestly not difficult. One is a tumor mass intruding on the gastric lumen, the other is an excavation in the gastric wall. Correspondingly, the visualized gastric chamber shows a local diminution, a filling defect, in the former, and a local expansion, a niche, in the latter. One is plus, the other minus. These lesions are easily diagnosed; many are operated on and for the most part adequately proved.

From a pathologic standpoint this classification is rather diagrammatic. Between the classic tumor and the classic ulcer are innumerable gradations according to the predominance of one or the other feature. At operation are found ulcerating cancers, ulcers which contain a minority of cancer cells, and benign ulcers with or without surrounding tumefaction.

Roentgenologically we are obliged to group these lesions in two general diagnostic classes, the tumorous and the ulcerous. The tumorous lesions are commonly diagnosed by the roentgen ray as cancer, because experience has taught us that nearly all the gastric tumors are carcinomatous. The ulcerous lesions are reported by the roentgenologist as ulcers because the characteristic niche-deformity is within the wall of the stomach. When they are exposed at operation they generally have the macroscopic appearance of benign ulcer, but microscopic examination of tissue from the ulcer sometimes reveals cancer.

Ulcers which show microscopic evidence of cancer may be divided into two types. In one type both the border and the floor of the ulcer contain cancerous tissue in abundance, (Fig. 1.). These are generally believed to be ulcerating cancers which were malignant from the beginning. This was the opinion of Hauser who stated that in a primary cancer-ulcer the entire border and floor are constantly more or less infiltrated with cancerous tissue, inasmuch as the infiltration precedes the ulceration. In the second type the floor of the ulcer does not contain cancer but cancer is found in the ulcer margin. (Fig. 2). This type has been given special attention in connection with the development of can-

*Read at the Twenty-Second Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Washington, D.C., Sept. 27-30, 1921.

cer on ulcer, a theme which has stimulated an extensive literature.

Many articles have been published by clinicians, surgeons, and pathologists representing every shade of opinion from that of Hirschfield, who denied any relation at all between gastric cancer and ulcer, to that of Zenker who held that most gastric cancers develop on ulcer. (See in bibliography, 1,4, 5, 7, 9, 10, 11, 12, 13, 14, 16, 17, 20, 21, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 40, 41, 42, 43.)

Except Hirschfield, who seems to be alone in his view, all agree that cancer may develop on ulcer, and only the frequency of such development is in controversy. Regardless of the issue of this debate, it is difficult to escape the conclusion that any ulcer is a potential cancer. The obvious corollary is that treatment should be surgical and the ulcer excised or destroyed.

Many malignant ulcers, particularly those containing small amounts of cancerous tissue, appear to be ulcers simply and solely, as seen by roentgenologists, clinicians, and surgeons. Abundant evidence can be gathered to substantiate this claim. Surgeons and pathologists see these lesions daily and have learned that they cannot depend on a gross examination to determine whether they are malignant or benign. W. J. Mayo says, "Even at operation it is sometimes difficult to determine whether the condition is cancer or ulcer . . . until a specimen is secured for microscopic examination." In a report of a number of such lesions, Wilensky and Thalheimer say, "In all these it was not possible to make the diagnosis of malignancy from the gross appearance of the specimens as they were observed at operation." Even in those adjudged to be benign microscopic diagnosis, they state, was arrived at with difficulty in a few because of atypical hyperplastic forms at the margin.

Ewing has made the statement, "In my own material I have had much difficulty in deciding how to interpret some ulcerating and cancerous lesions."

Küttner states, "In many cases it is not possible, either clinically or with the abdomen open, macroscopically to differentiate callous ulcer from cancer. The microscopic examination alone makes the differential diagnosis".

Payr, likewise, states, "Clinically, historically, and even after thorough macroscopic examination of the specimen a case may appear to be one of quite typical ulcer, and the subsequent histologic examination first tells us in an unequivocal way, the unpleasant fact that a beginning or advanced cancer is present".

Orth remarks that the macroscopically ulcerous appearance can never be relied on.

MacCallum has seen typical round ulcers, in the margins of which carcinomatous growth of epithelium of unmistakable character was found, although the tumor had not developed sufficiently to disturb the characteristic appearance of the ulcer.

Aschoff asserts that often only the microscope can determine whether or not a cancerous ulcer is present, and that the microscopic distinction is not always easy.

Henke believes that to determine macroscopically without sectioning whether a callous gastric ulcer is or is not cancerous is impossible in many cases.

From the roentgenologic standpoint Clairmont and Haudek write as follows: "Although many criteria make it possible to differentiate cancer from ulcer, this distinction is risky in a certain group of cases well diagnosed as chronic ulcer, whose transition into cancer cannot be excluded. . . . . Since at laparotomy the surgeon has difficulty in making the differential diagnosis macroscopically, since both diseases cause infiltrated glands, indeed since the histologic examination must be conducted most thoroughly in order not to overlook small groups of cancer cells, it can be understood that here roentgen diagnosis must find a limit". Again, they state, "The wide consensus of view that a chronic ulcer should have surgical treatment makes its differentiation from cancer superfluous. Certain it is that thereby many times the generation of a cancer will be prevented".

All this testimony is fairly representative of the mass of opinions and indicates the vanity of any hope we might have entertained that the roentgen examination may succeed in a task which is sometimes difficult for the microscope.

MacCarty has said, "If the surgical pathologist cannot always distinguish grossly simple, chronic, gastric ulcers from carcino-

FIG. 1. CASE 206304. Malignant ulcer, niche-type. Cancer in floor and margin. Arrow indicates crater.

matous gastric ulcers, it is impossible for surgeons, roentgenologists and clinicians to make the differentiation with their lesser instruments of observation, there being no specific clinical or laboratory test for early cancer".

Conceding the justice of my colleague's criticism from the strict point of view of the pathologist, I believe, nevertheless, that to impose such limitations of diagnostic latitude would, under present conditions, impair the practical efficiency of the roentgen-ray examination. With the increased capability of the roentgen ray, clinicians and surgeons place correspondingly increased reliance on it, not only for the demonstration of gastric lesions but also for the determination of

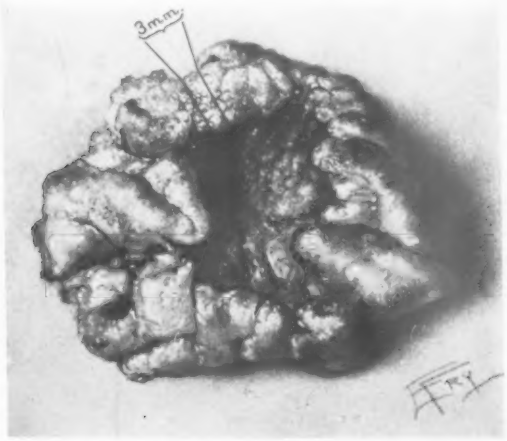


FIG. 2. CASE 346077. Malignant ulcer, niche-type. Cancer found over an extent of 3 mm. only, in margin.

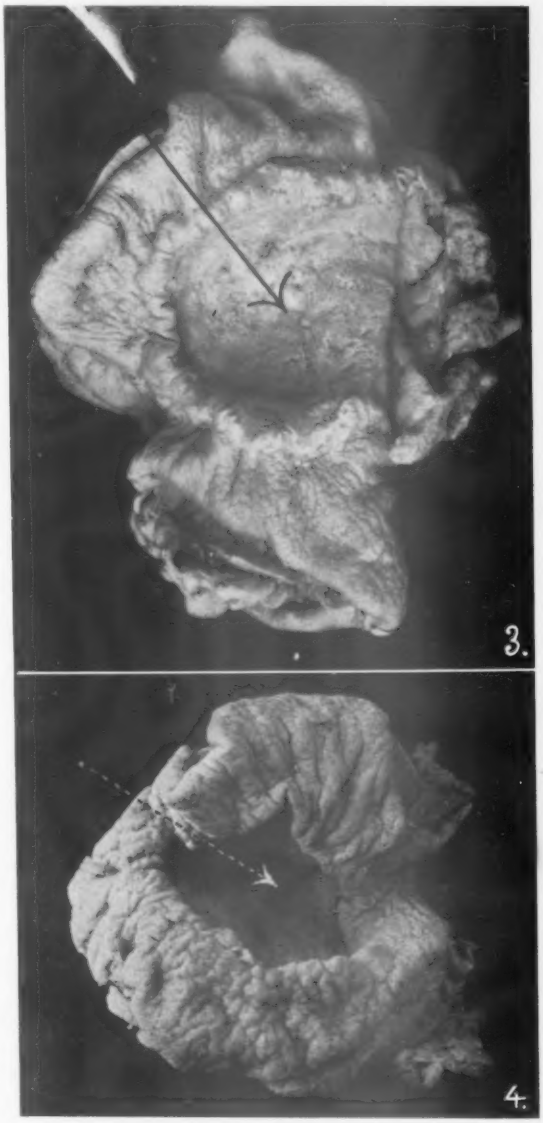


FIG. 3. CASE 262866. Ulcerating cancer. Large deep ulcer with overhanging margin. This is the type of ulcer whose crater may be seen as a meniscus during fluoroscopy.

FIG. 4. CASE 166828. Ulcerating cancer, having the same characteristics as the one shown in Figure 3.

their probable character. That this reliance has not been entirely misplaced is, I believe, abundantly proved. On the other hand, I do not recommend or practice diagnosis on mere suspicion. All conclusions from the roentgen examination should be well reasoned, and the examiner should not be expected to give information which he cannot possibly obtain.

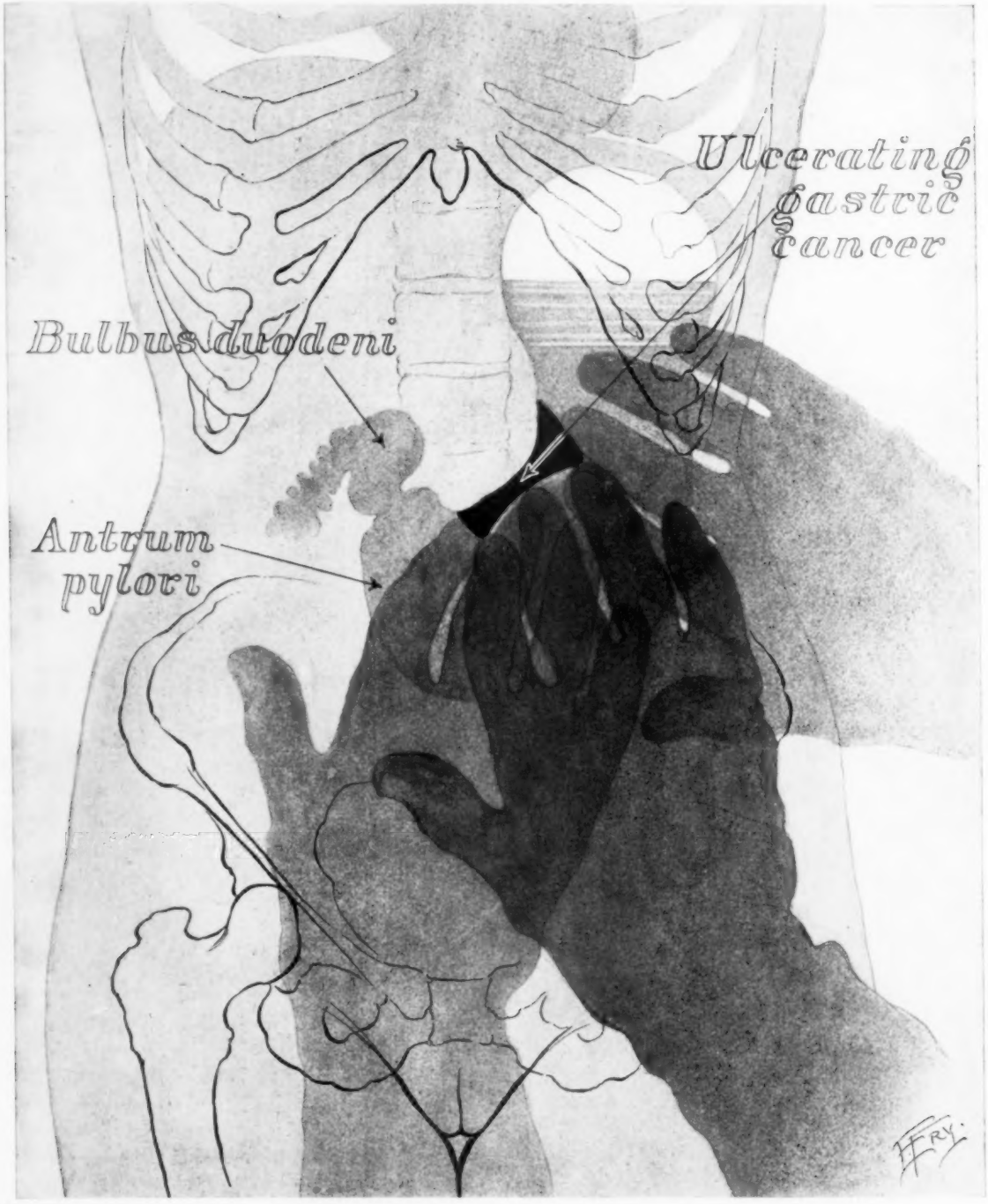


FIG. 5. Drawing illustrating the demonstration of the lesion by palpation during roentgenoscopy.

It would seem that the roentgenologist is between two fires. On one side is the clinician who desires a maximum of diagnostic detail, and on the other is the pathologist who insists that the roentgen ray can furnish only a minimum of positive information.

At the roentgen laboratory of the Mayo Clinic we report the well defined ulcerous gastric lesion of the niche-type as "ulcer", be-

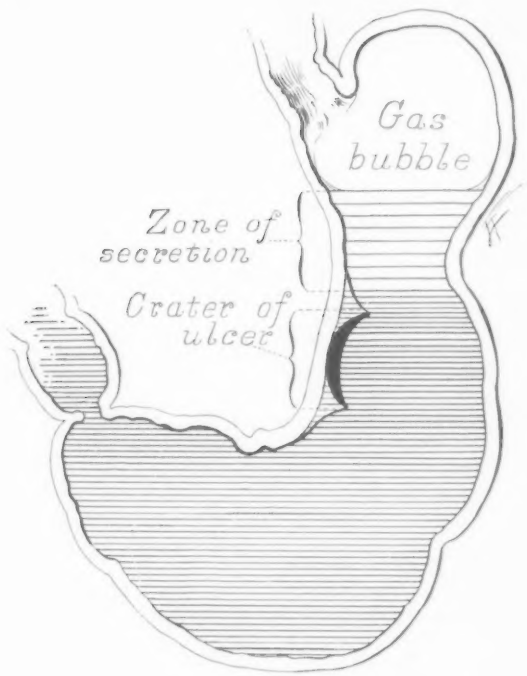


FIG. 6. Drawing illustrating meniscus-like appearance of crater seen in profile. Ulcer on the posterior wall near the lesser curvature.

cause in its gross characteristics it is an ulcer, and the examiner's associates understand very well that he cannot determine whether its histologic structure is benign or malignant. Likewise, a gastric filling defect with a palpable tumor is reported by us as "cancer", because experience has shown that 95 per cent of such tumors are cancers, and the empirical element in the diagnosis is thoroughly comprehended by all concerned. But when the clinician is not thoroughly acquainted with the roentgenologist's method of examination and his manner of expressing the results the latter should report his diagnosis in guarded terms. A lack of caution in this respect adds to the doubt of those who view roentgen diagnosis with skepticism.

As I suggested at the beginning of this paper some ulcerating cancers have the gross characteristics of both ulcer and cancer, (Figs. 3 and 4). When a cancer has undergone deep ulcerous excavation and the ulcer is surrounded by a wall-like overhanging margin it may present certain pathological peculiarities which I have recently described[6] and which I consider pathognomonic. Fluoroscopic examination is required to elicit these characteristics because palpatory manipulation is indispensable (Fig. 5). The picture thus obtained varies slightly with the site of the ulcer.

If the lesion is on the vertical portion of the lesser curvature or on the posterior wall near the lesser curvature, approximation of the walls of the stomach by palpation causes the crater of the ulcer to appear on the screen as a dark shadow resembling a meniscus as seen in profile (Fig. 6). The convexity of the meniscus is directed outward toward the gastric wall and its concavity toward the gastric lumen. When the ulcer saddles the lesser curvature of a fishhook stomach distal to the incisura angularis, the floor of the ulcer bends with the lesser curvature and its concavity is directed outward (Figs. 7 and 8). If the ulcer is high in the stomach on the posterior wall, well away from the curvature, thinning the barium by manual pressure reveals the crater as a somewhat rounded dense shadow encircled by a lighter zone, but no crescent is seen as when viewed edgewise (Fig. 9). By turning the patient into the lateral view and palpating the stomach the meniscus-like appearance of the crater may sometimes be obtained. It will be under-

FIG. 7. CASE 365132. Roentgenogram of ulcerating cancer saddling the lesser curvature, at the pyloric end of the stomach. Arrows point to meniscus. Irregularity of greater curvature due to spasm (Specimen, Figure 8).

FIG. 8. Same case as in Figure 7. Ulcer sectioned through the lesser curvature showing half of the crater. Note the thick indurated base and overhanging margin.

stood readily that other modifications of this sign may result from variations of the pathologic condition or situation of the lesion. For example, the floor of the ulcer may be flat instead of curved and show in profile as a straight line. The manner of palpation and degree of pressure exercised also affect the outline of the visualized crater, so that it may appear rectangular or biconcave, or otherwise.

Briefly summarized, the visualized crater of this ulcer differs from the classic niche-type in three particulars: (1) the crater is not within the wall of the stomach and therefore does not project from the visualized gastric lumen; (2) in profile the crater appears as a meniscus; and (3) it tends to retain its barium content during palpatory maneuvers and is not easily emptied (Fig. 10).

For two or three years I have been observing ulcerous lesions with the foregoing characteristics. Operative and pathologic findings, both gross and microscopic, have consistently verified the diagnosis of cancer.

On the other hand the niche-type of ulcer (Figs. 11 and 12) produces virtually the same roentgenologic manifestations whether it is benign or malignant, and any prediction of its probable character based on the roentgen-ray findings is hazardous (Figs. 13 and 14).

Large size of the ulcer crater is one indication of malignancy. When the niche representing the crater is 2.5 cm. or more in diameter, cancer is usually found in the ulcer on microscopic examination (Fig. 15). Unfortunately a smaller ulcer may also be carcinomatous, or a larger one may exceptionally be benign.

In this connection it should be mentioned that a perforated ulcer producing an accessory pocket, no matter how large, is seldom malignant. It is true that an ulcerating cancer may break through the gastric wall and attach itself to adjacent tissue, but filling defects suggesting the presence of a tumor are also likely to be seen.

A marked filling defect or gross deformity of the gastric outline adjacent to a niche may suggest malignancy. Such deformities, however, are most often due to induration, perforation, adhesions, or spasm accompanying a benign ulcer.

Other minor manifestations of benign and malignant niche ulcers offer little or no

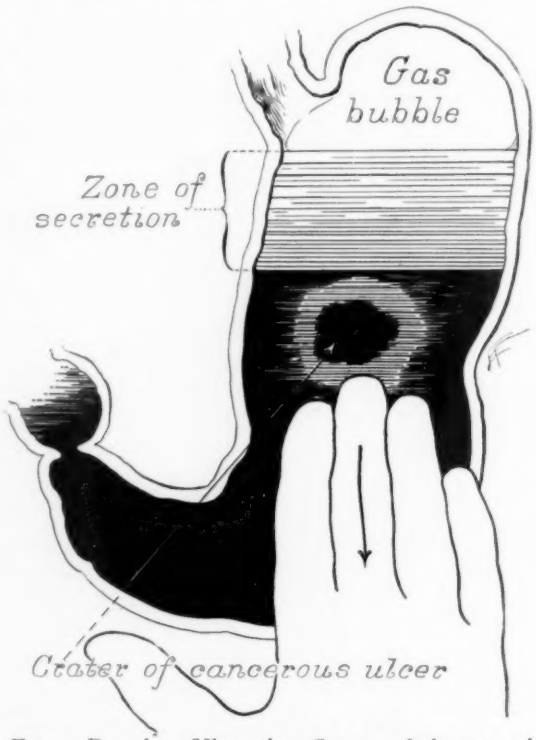


FIG. 9. Drawing. Ulcerating Cancer of the posterior wall. Appearance of the crater at roentgenoscopy on palpation.

FIG. 10. CASE 371607. Roentgenogram negative. Ulcerating cancer on the posterior wall of the middle portion of the stomach, near the lesser curvature. Meniscus-like crater seen at roentgenoscopic examination.

aid in the effort to distinguish between them. Cancers which are not mechanically obstructive are commonly associated with achylia and a gaping pylorus, while benign ulcers, even though distant from the pylorus, are likely to be accompanied by hyperacidity, spasticity of the pylorus, and six-hour retention. But such findings are not constant in either variety of ulcer, and only slight weight can be attached to them.

The broad incisura of cancer and the narrow incisura of ulcer, both of which are contractures of the greater curvature in the plane of the lesion, depend on the extent rather than on the character of the lesion. Thus, while a broad incisura would correspond to an extensive lesion which because of its size is open to the suspicion of malignancy, the small ulcer with a narrow incisura is not wholly exempt from mistrust.

Alterations of peristalsis are of trifling differential significance. A gross malignant ulcer is more often associated with anacidity and peristaltic sluggishness, a simple ulcer with hyperacidity and peristaltic vigor, but the reverse may occur, and it would be folly for the examiner to be influenced by the peristalsis observed.

SUMMARY

There are but two varieties of ulcerous lesions which evince any noteworthy roentgenologic indications of malignancy. One is the ulcerating cancer with the meniscus-like crater. The other is the niche-type of ulcer with an unusually large crater. With these exceptions the examiner cannot venture opinions as to the probable character of ulcers revealed by the roentgen ray, nor should he be expected to do so. Any ulcer which appears to be benign macroscopically may prove to be malignant microscopically. Cancer may arise in an ulcer which was primarily benign.

However interesting and important these facts may be to roentgenologists, clinicians, surgeons, and pathologists, they are vastly more important to the patient, whose welfare should be our first consideration.

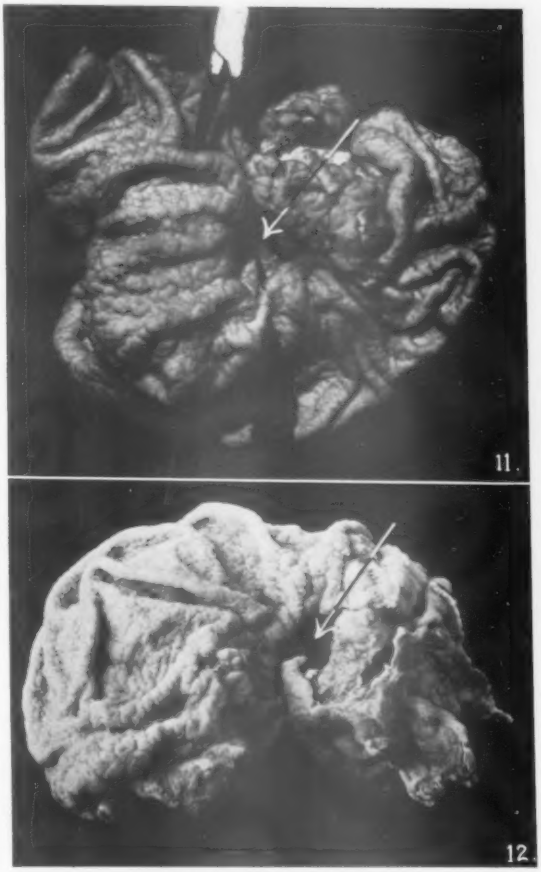


FIG. 11. CASE 346353. Benign ulcer. Arrow points to crater. Note similarity to Figure 12.

FIG. 12. CASE 292220. Malignant ulcer. Arrow indicates crater. Compare with Figure 11.

FIG. 13. CASE 154564. Roentgenogram. Niche-type of ulcer, benign. Arrow points to niche. Compare with Figure 14.

FIG. 15. CASE 20799. Roentgenogram. Niche-type of ulcer. Niche extraordinarily large. Operation. Cancer demonstrated microscopically.

FIG. 14. CASE 116521. Roentgenogram. Niche-type of ulcer, malignant. Arrow points to niche.

BIBLIOGRAPHY

1. ADAMI, J. G., AND NICHOLLS, A. G. Principles of pathology. Philadelphia, 1909, ii, p. 417.
2. ASCHOFF, L. Ueber die mechanischen Momente in der Pathogenese des runden Magengeschwürs und über seine Beziehungen zum Krebs. *Deutsche. med. Wchnschr.*, Berl., 1912, xxxviii, 494-496.
3. ASCHOFF, L. Pathologische Anatomie. Jena, 1919, ii, 824; 839.
4. ASSMAN, H. Die Roentgendiagnostik der inneren Erkrankungen. Leipzig, 1921, 385; 419; 693.
5. BLAND-SUTTON, J. Ulcers new and old; jejunal for duodenal ulcers. *Lancet*, 1916, i, 387-391.
6. CARMAN, R. D. A new roentgen-ray sign of ulcerating gastric cancer. *J. Am. M. Assn.* 1921, lxxvii, 990-992.
7. CHENEY, W. F. Gastric cancer as a sequel to gastric ulcer. *J. Am. M. Assn.*, 1915, lxv, 1227-1231.
8. CLAIRMONT P., AND HAUDEK, M. Die Bedeutung der Magenradiologie für die Chirurgie. Jena, 1911, p. 53.
9. DEAVER, J. B. Gastric ulcer. *Am. J. M. Sc.*, 1915, cxlix, 325-337.
10. EWING, J. The relation of gastric ulcer to cancer. *Ann. Surg.*, 1918, lxvii, 715-724.
11. FRIEDENWALD, J. A clinical study of one thousand cases of cancer of the stomach. *Am. J. M. Sc.*, 1914, cxlviii, 660-680.
12. HAUSER, G. Zur Frage von der krebsigen Entartung des chronischen Magengeschwüres. *München. med. Wchnschr.*, 1910, lvii, 1209-1213.
13. HEMMETER, J. C. The transition of gastric ulcer into carcinoma and of gastric carcinoma into ulcer. *Med. Rec.*, 1915, lxxxviii,4-9.
14. HENKE, F. Primäres und sekundäres Ulkuskarzinom im Magen. *Centralbl. f. allg. Path. u. path. Anat.*, 1914, xxv, 416-417.
15. HIRSCHFELD. Quoted by Kaufmann.
16. HOLLAND, C. T. The hour-glass stomach. *Brit. M. J.*, 1921, i, 6-9.

17. KAUFMANN, E. Pathologischen Anatomie, Berlin, 1911, 444-454.
18. KONJETZNY, G. E. Ueber die Beziehungen der chronischen Gastritis mit ihren Folgerscheinungen und des chronischen Magenulcus zur Entwicklung des Magenkrebses. *Beitr. z. klin. Chir.*, Tübing., 1913, lxxxv, 455-519.
19. KONJETZNY, G. E. Der jetzige Stand der Lehre von der Beziehung des Magenkarzinoms zum Magengeschwür. *Deutsch. med. Wchnschr.*, Berl. & Leipz., 1920, xlvi, 285-287.
20. KUTTNER, H. Zur Beurtheilung und Behandlung des Ulcus callosum ventriculi. *Arch. f. klin. Chir.*, Berl., 1910, xciii, 410-414.
21. MACCALLUM, W. G. A Textbook of Pathology. Philadelphia, 1919, p. 976.
22. MACCARTY, W. C. Chronic gastric ulcer and gastric carcinoma. *Am. J. Roentgenol.*, 1920, vii, 591-596.
23. MAYO, W. J. The calloused ulcer of the posterior wall of the stomach. *Ann. Surg.*, 1920, lxxii, 109-113.
24. MAYO-ROBSON, A. W. The treatment of cancer of the stomach. *Lancet*, 1906, ii, 419-422.
25. MOULLIN, C. M. The early diagnosis of cancer of the stomach. *Lancet*, 1906, ii, 773-775.
26. MOYNIHAN, B. G. A. The early diagnosis of cancer of the stomach. *Brit. M. J.*, 1909, i, 830-834.
27. OCHSNER, A. J. The relation between gastric ulcer and cancer. *J. Am. M. Assn.*, 1915, lxv, 1073-1076.
28. ORTH, J. Pathologisch-anatomische Diagnostik. Berlin, 1917, p. 587.
29. PAUCHET, V. Gastropylorectomy for gastric ulcer. *Bull. Acad. de méd.*, Par., 1917, lxxviii, 741. Abstr. *J. Am. M. Assn.*, 1918, lxx, 492.
30. PAYR, E. Erfahrungen über Excision und Resection bei Magengeschwuren. *Arch. f. klin. chir.*, Berl., 1910, xcii, 199-254.
31. PAYR, E. Beiträge zur Pathogenese, pathologisch en Anatomie und radicalen operativen Therapie des runden Magengeschwürs. *Arch. f. klin. Chir.*, Berl., 1910, xciii, 436-496.
32. PECK, C. H. Cancer of the stomach. *Surg., Gynec. and Obst.*, 1917, xxiv, 549-552.
33. POWER, D'A. Discussion of papers by W. H. White and B. G. A. Moynihan. *Brit. M. J.*, 1909, i, 845.
34. REHFUSS, M. E. Diseases of the stomach. In: Oxford Medicine. New York, 1921, iii, 101.
35. RIBBERT, H. Allgemeinen Pathologie und pathologischen Anatomie. Leipzig, 1920, p. 487.
36. RODMAN, W. L. How frequently do gastric ulcers become carcinomatous? *Ann. Surg.*, 1908, xlvii, 922-923.
37. RODMAN, W. L. Pylorectomy and partial gastrectomy or excision of the ulcer-bearing area in the treatment of gastric ulcer. *Surg., Gynec. and Obst.*, 1915, xx, 25-30.
38. SIERRA, L. Partial gastrectomy in the treatment of chronic indurated ulcers of the stomach. *Surg., Gynec. and Obst.*, 1917, xxiv, 694-696.
39. SIPPY, B. W. Diseases of the stomach. In: Musser, J. H., and Kelly, A. O. J.: A Handbook of Practical Treatment. Philadelphia, 1912, iii, p. 343.
40. STROMEYER, F. Die Pathogenese des Ulcus ventriculi, zugleich ein Beiträg zur Frage nach den Beziehungen zwischen Ulcus und Carcinom. *Beitr. z. path. Anat.*, Jena, 1912, liv, 1-67.
41. URRUTIA, L. [Malignant degeneration of gastric ulcer.] Arch Espanoles de Enf. del App. digestif, 1919, ii, 579. Abstr. *J. Am. M. Assn.*, 1919, lxxiii, 1967.
42. WHITE, W. H. The early diagnosis and treatment of cancer of the stomach. *Brit. M. J.*, 1909, i, 828-829.
43. WILENSKY, A. O., AND THALHEIMER, W. The etiological relationship of benign ulcer to carcinoma of the stomach. *Ann. Surg.*, lxvii, 215-225.
44. ZENKER. *Berl. klin. Wchnsr.*, 1882, xix, 657.

DISCUSSION

DR. G. W. HOLMES. I hesitate to discuss a subject which has been presented by a man who has had such an extensive experience as Dr. Carman. But in our clinic at the Massachusetts General Hospital, we have a group of pathologists who practically never make a diagnosis of cancer on ulcer. The findings on which we base a differential diagnosis between cancer and ulcer are quite different from Dr. Carman's. We put considerable stress on the peristaltic function of the stomach.

Assuming that cancer is a primary lesion, then the duration of illness is so short that the muscular structure of the stomach does not have time to hypertrophy, and we do not get the extreme hypermotility that we see in chronic ulcer. In our clinic, we are examining about 2,000 cases a year. We have not analyzed them so carefully as Dr. Carman has.

In 1914, we reported the results of our cases, and in 1920, we tabulated them again. Our findings ran much the same in 1920, as they did in 1914. We found a considerably larger number of cancers than ulcers. I think it would be fair to assume one of two things. Either we must be missing a considerable number of ulcers, or cancer is more frequent than ulcer in our clinic. Supposing that most cancers arise on ulcers, then we ought to find more ulcers than cancers, but we do not find this to be true. If we were missing them, the surgeon would check us up. In all cases,we have a brief history taken. It is not like the one which the gastroenterologist would make—perhaps, it is a little better in some ways, because we do not suggest anything. Take a large number of these cases and note the duration of time elapsing from the first symptoms until the lesion is found. Most cancer cases will come within a

period of months, whereas ulcer cases come within a period of years.

I think that the differences in our observations and those of Dr. Carman are not due to technique, as we use practically the same, but rather to the difference in the opinion held by the pathologist with whom we work.

Dr. Franklin W. White. One thing which appealed to me in the remarks of Dr. Carman was the fact that fluoroscopy and careful palpation were necessary to discover some of these cancers. I was struck with the large size of some of the cancers which he showed in his diagrams which did not show on the plates. Sometimes roentgen examinations of the stomach are carried through without fluoroscopic examination—I think, however, that this is done less and less, and I am sure that we have been shown that even such a large, serious, and important lesion as a well developed cancer on the posterior wall of the stomach may be entirely missed without the use of the fluoroscope. Nothing is more serious or embarrassing, and nothing brings more discredit on the roentgen examination than to entirely miss a good sized gastric cancer. I feel sure that this method of fluoroscopy and palpation which Dr. Carman has described will prove very valuable in this field. With regard to the frequency with which cancer may develop upon ulcer, that question, is still under a great deal of discussion. As a clinician it seems to me that it occurs much less frequently than we should expect from the statistics which have come from the Mayo Clinic.

Dr. Carman (closing the discussion). A number of things were brought up in the discussion which are irrelevant to the paper. Exact proof of the development of cancer on ulcer is difficult to obtain. No one has ever seen the process of transformation in actual progress. Yet most pathologists agree that it does occur, and disagree only as to the frequency of its occurrence. Some have estimated that 80 per cent of cancers have developed from ulcers. Personally, I do not believe that the percentage is as high as was originally thought.

The cases that give the meniscus sign are few in number. We have seen only twenty-five or thirty in the last three or four years. Cancer is an ulcerating disease, but many ulcerating cancers do not give this sign. Only those with deep craters and overhanging margins can be seen in this form. All that we have met with have been malignant. As was shown in the slides palpation is absolutely essential to demonstrate this lesion when it is above the incisura angularis. I am quite sure that early in our work we have missed diagnosing many of these cases.

ROENTGENOLOGICAL STUDIES OF INJECTED KIDNEYS*

By W. K. LIM, M.D.

Department of Research, Jefferson Clinic

DETROIT, MICHIGAN

THERE is no other system in the human body which presents such peculiarities of development as the urogenital system. The nephridial system is even more complicated than the reproductive. This is due to its three stages of development which eventually merge into one, the metanephric stage. When the pronephric stage is succeeded by the mesonephric and the mesonephric in turn by the metanephric is still a matter of conjecture.

The developmental peculiarities of the nephridial unit alone are sufficient to make the study of the subject interesting as well as instructive. They afford an inexhaustible field for further investigation and research.

In the preparation of this paper, the writer is fully conscious of the depth and magnitude of the subject. He therefore at this time simply wishes to present a preliminary report of his work on injected kidneys, viewing the question particularly from the standpoint of pyelography. He hopes in the course of the discussion, to be able to give a few new facts additional to those which have already been written upon and discussed by other writers.

In the daily routine of *x*-ray work on kidneys one is often puzzled in his attempt to give a true interpretation of shadows cast

*Read at the Twenty-Second Annual Meeting of The American Roentgen Ray Society, Washington, D.C., Sept. 27-30, 1921.

by the renal pelves and calyces; in other words, to determine where the normal ends and the pathological begins. This desire to know as much of the truth as possible regarding the actual shadows of kidneys upon the sensitized *x*-ray plates, unobstructed by the intervening tissues and unaltered by pressure caused by neighboring organs or by distended blood-vessels, has led the writer to go further into the study.

The specimens used in this work include:

1. Freshly removed kidneys of adults, children, and feti from autopsy and surgical cases.

2. Freshly removed kidneys of animals, which as far as can be ascertained are normal.

3. Kidneys injected in situ soon after death.

4. Pathological kidneys injected before and after surgical intervention. Follow-up cases.

Before going further into the discussion, it is well that we freshen our minds with a short review of the gross anatomical structures and landmarks of the renal ducts. Regarding the urogenital system from the standpoint of its embryological development, the nephridial unit consists of:

1. The ureter.

2. The pelvis proper and its branches, the calyces.

An adult ureter is a pale-colored, thick-walled duct with a small lumen. It measures while in situ about 25 cm. in length, extending from the pelvis to the urinary bladder. It has normally three narrowings:

1. At a distance from 4 to 9 cm. below the hilus of the kidney.

2. Near the brim of the bony pelvis.

3. At the lower end of the ureter as the duct penetrates the wall of the bladder.

The pelvis, as a rule, is irregularly pyramidal in shape, tapering gradually until it reaches the ureteropelvic junction, at the region of the first narrowing. It is placed partly within and partly outside the sinus. Opinions differ as to the number of the main divisions of the pelvis of the kidney. Piersol says: "These include the divisions of the pelvis into an upper and a lower segment (calyces majores), extending towards the respective poles of the kidney." Cunningham puts it in this manner: "It is formed by the junction of two, or more, rarely three, thin-walled tubes, the calyces majores, each of which has a number of branches." Braasch, on the other hand, in describing the major calyces of the kidney, says: "The major calyces are commonly three in number, the upper, the middle, and the lower." For descriptive and practical purposes, and especially from the standpoint of pyelography, the writer prefers to look upon the renal pelvis as having three divisions like those seen in the primitive type of renal pelvis. He, therefore, will make use of Braasch's description as a working basis in the course of the discussion of the paper.

The pelvis, then, let us say, divides into three main divisions called the superior, middle and inferior major calyces, each occupying the upper pole, the middle portion, and the lower pole of the kidney respectively. Each of the major calyces, after springing from the pelvis proper in the form of a stem, subdivides into from four to six smaller branches known as the minor calyces. The terminal ends or apices of the minor calyces open up like so many buds in a rather broad cup-like depression. The latter form receptacles into which the renal papillae empty.

The foregoing brief description gives us a fair view of the structure of the renal ducts as generally conceived. But in actuality and in daily *x*-ray work, one unfortunately does not find them to be always so. They are subject to extreme variations and anomalies.

From the study of the various roentgenograms of normal renal pelves and blood-vessels, the writer is prepared so far in his investigation to give the following findings:

First, that work upon normal kidneys of adults, infants, and feti reveals that there is always a constant dissimilarily in capacity, size and shape of the pelves and the number of calyces, not only between two different persons, but also between the two kidneys removed from the same subject.

Second, that the superimposition of the shadow of one or more calyces upon the other portion of the calyces and pelvis will throw a shadow which often resemble a stone in the pelvis. Again, if the cup-like terminal depression of the minor calyx happens to be a very deep one, it will produce a ring-like shadow of less density than the main shadow, and this may be mistaken for a

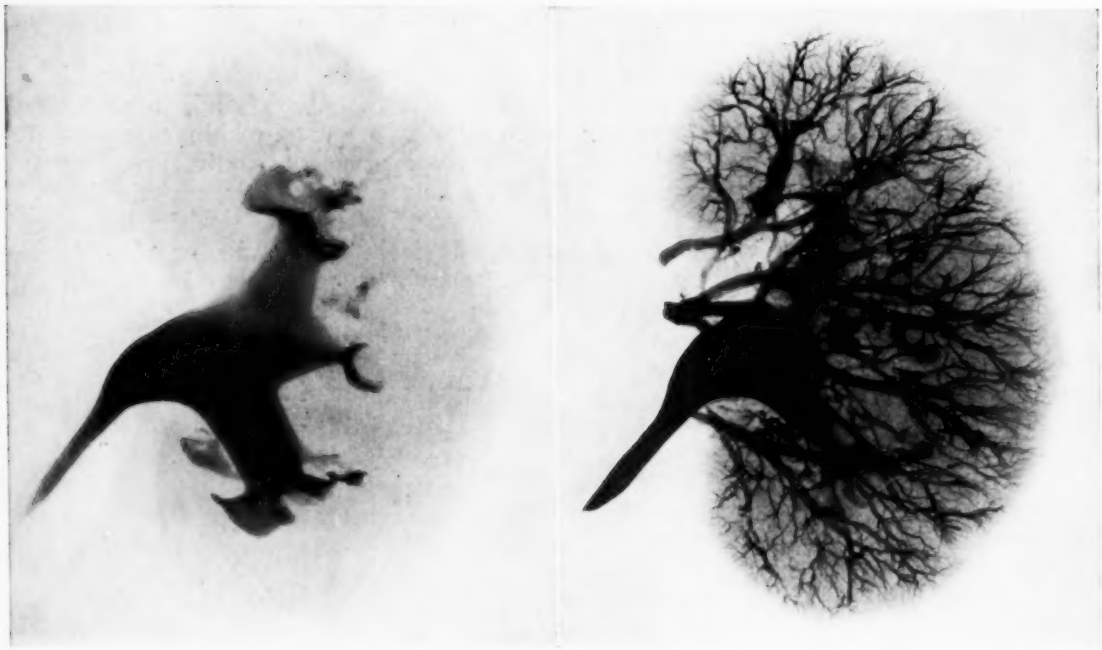


FIG. 1. FIG. 2.

FIG. 1. CASE 1. Pyelogram of normal human kidney. Three major calyces are present. The middle major calyx is very small. There is a complete absence of the minor calyces, the major calyces terminating directly in terminal depressions.

FIG. 2. CASE 1. Pyelogram of normal human kidney, showing the relation of the renal arteries to the pelvis and calyces in this particular specimen. The veins were not injected. Note the partial obliteration and constriction of the superior and inferior major calyces, caused by the crossing of the arteries.

renal calculus. Very frequently also the main renal vessels cross the upper portion of the pelvis, the isthmus of the major calyx and the minor calyx. The crossing of these vessels, especially if they are in a state of distention, will bring about a distorted and an abnormal shadow, isolating either the minor and major calyx from the main body of the pelvis or producing a partial obliteration or constriction of the isthmus. This condition will again make the interpretation of the pelvis shadow erroneous.

Third, everything being equal, the ureteropelvic junction of the four kidneys of infants, aged nine and twelve respectively, show a constant tortuosity. The tortuosity can be better demonstrated on the stereoscopic screens. It is not due to faulty technique nor to post-mortem contracture, for they were removed and prepared in exactly the same manner as the other kidneys of infants and feti. The writer does not wish to comment or advance any theory regarding this unusual finding, for it is too premature, and further, the materials worked upon so far are not sufficient in number to warrant one to draw any conclusion. Further study will be made upon this particular question. Pedicles of a twelve-day old baby, and of five and six months old feti do not give this picture.

Fourth, in the two extremes of age, the calyces are easily ruptured. In the very young this is due to the friability and thinness of the walls of the pelvis and the calyces, whereas in old people it is due to the brittleness and unyielding condition of the walls. This teaches one a good point in pyelography, in that pressure used in one's attempt to introduce opaque medium into the pelvis is beset with dangers. Gravity method is the safest, although it may take considerable more time in the procedure. The writer hopes to be able to demonstrate satisfactorily the above points on the lantern slides.

Taking the time element into considera-

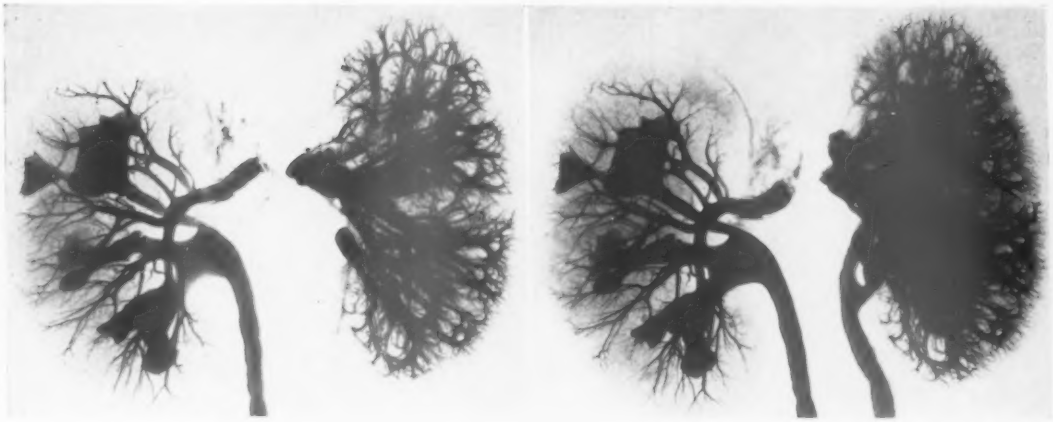


FIG. 3. FIG. 4.

FIG. 3. CASE X. A. Pair of kidneys from the same subject. The right one shows simply the blood-vessels. The ureter and pelvis were not injected. The left one shows a pyelogram of the kidney with the main arteries injected, demonstrating their relation with the structures of the pelvis.

FIG. 4. CASE X. B. The same as Case X A. Note particularly the pyelogram of the right kidney. There is an attempt on the part of the ureter toward duplication. Complete absence of the pelvis.

tion, the writer is obliged to describe at most only two cases from each set of kidneys. There are four sets in all, covering an investigation work on fifty-five kidney specimens. The first set consists of normal adult kidneys; the second, of normal fetus and infant kidneys; the third, of animal kidneys, and the fourth of pathological human kidneys.

CASE I. (Figs. 1 and 2). Male, aged thirty-five. Cause of death: Epithelioma of the lung, secondary metastasis of the esophagus.

Specimens: Left Kidney. The first injection is to show the outline of the kidney pelvis and calyces. The second injection shows the relation of the renal artery to the pelvis and calyces. This is a normal pelvis. Number of major calyces, three. The superior major calyx terminates into just one broad papillary depression without having a minor calyx. The middle major calyx springs directly from the pelvis proper, terminating in a small papillary depression. The inferior major calyx is broad, terminating in four papillary depressions, deep and hollow. One of the depressions superimposes the isthmus of the calyx, simulating the shadow of a calculus. The minor calyces in this case are wanting, the apices of the major calyces ending abruptly in papillary depressions. The distended arteries of the upper pole cross and hug closely the isthmus of the upper major calyx and also that of the middle major calyx, producing a partial obliteration and isolating the terminal portions of the calyces from the pelvis proper.

CASE II. Female, aged twenty-three. Cause of death: Attempt made on part of patient to induce self-abortion, by taking some proprietory preparation of ergot. Autopsy revealed that there was no product of conception present. There was however a polyp hanging from the fundal portion of the uterus.

CASE III. Female, aged twenty-five. Cause of death: Suspected drug addict, having taken an overdose of habit-forming drug.

CASE IV. Male, aged twenty-seven. Cause of death: Very malignant sarcoma. Death very rapid.

CASE VI. Male, aged forty. Cause of death: Accidentally buried in a sewer which caved in while he was working in it.

CASE VII. Female, aged twenty-six. Cause of death: double pneumonia.

CASE VIII. Female, aged thirty. Patient is living and well at present. Diagnosis: Pyonephrosis. Pelvic Kidney.

CASE IX. Female, aged sixty. Cause of death: Generalized carcinoma.

CASE X. (Figs. 3 and 4). Male, aged thirty. Cause of death: Asphyxiation.

Specimens: Two Kidneys. In the first in-

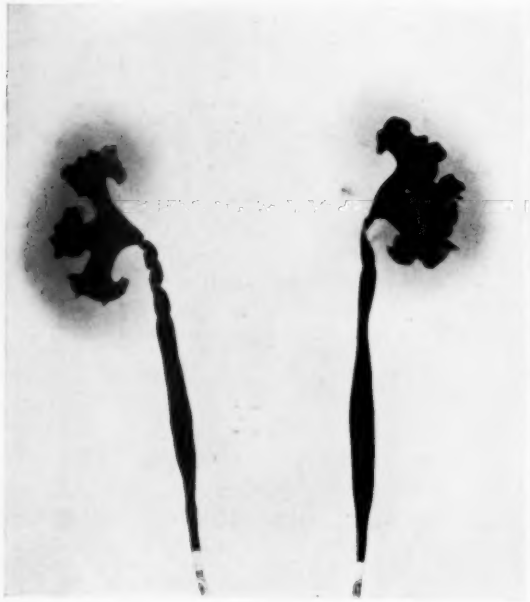


FIG. 5.

FIG. 6.

FIG. 5. CASE XIV. Pyelo-ureterograms of a pair of infant kidneys. Aged nine months. This case is to demonstrate the tortuosity of the pedicles of both kidneys. The blood-vessels were not injected. The pelvis proper is relatively large and the minor calyces bud out almost directly from the pelvis proper. Stereoscopically seen, the three major calyces have eight minor calyces. This is a typical type of renal pelvis in its early developmental stage.

FIG. 6. CASE XIV. Pyelo-ureterograms of a pair of infant kidneys. Aged nine months. This case is to demonstrate the relation of the blood-vessels to the pelvis and calyces. Note the dissimilarity in the shape of the two pelves.

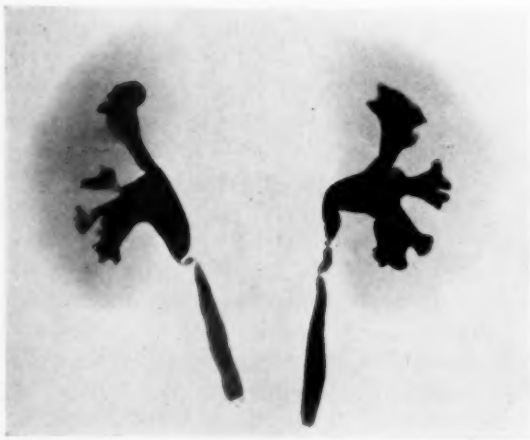


FIG. 7.

FIG. 8.

FIG. 7. CASE XV. Pyelo-ureterograms of a pair of infant kidneys. Aged twelve months. This case, like Case XIV, is to demonstrate the tortuosity of the pedicles of both kidneys. The blood-vessels were not injected. The right kidney shows three distinct major calyces, whereas the left kidney shows a diminutive form, budding out as part of the inferior major calyx. Note the difference in shape between the two pelves.

FIG. 8. CASE XV. Pyelo-ureterograms of a pair of infant kidneys. Aged twelve months. This case, like Case XIV, is to demonstrate the tortuosity of the pedicles of both kidneys. Both the arteries and veins were injected, so as to show their relation to the pelves and calyces.

jection the right kidney pelvis and ureter were not injected, only the arteries and veins. In the left kidney the ureter, pelvis and the arteries only were injected, whereas the veins were left untouched. In the second injection the pelvis and ureter of the right kidney were injected. It is interesting to note in the case of the right kidney that there is a complete absence of the pelvis; the superior and inferior major calyces spring directly from the pelvis, the superior major terminating in a broad apex with two terminal depressions, and the inferior major in two minor calyces. The left kidney has a relatively small pelvis. Three major calyces are present. The superior springs directly from the upper margin of the pelvis in the form of a long narrow isthmus with broad apex. The latter has two papillary depressions. The middle also springs directly from the pelvis in a long narow isthmus with two minor calyces at its terminal portion. The inferior is short and divides at its terminal portion into three minor calyces, each having one papillary depression. The ureter is abnormally large. There is an attempt toward duplication on the part of the ureter.

Case XI. Male fetus, aged five months. Miscarriage.

Case XII. Male fetus, aged six months. Miscarriage. Kidneys were injected in situ.

Case XIII. Male infant, aged twelve days. Malnutrition.

Case XIV. (Figs. 5 and 6). Male infant, aged nine months. Pyloric stenosis. Especially interesting in that the pedicles of both kidneys show tortuosity. The shape of the right pelvis is a type seen in early pelvis. All the calyces spring directly from the pelvis. In the first injection only the ureters and pelves were injected. In the second injection both the arteries and veins were injected.

Case XV. (Figs. 7 and 8). Male infant, aged twelve months. Malnutrition. The same condition of the pedicles of both ureters exists as in Case XIV, only that the tortuosity is more marked.

Case XVI. (Fig. 9). Kidney of beef. The architecture of this kidney much resembles that of the fetus of five months, with but one exception. The upper and lower poles of the pelvis throughout their entire length branch out into secondary divisions, and each of the secondary divisions in turn subdivides into two, three and four minor calyces. The papillary indentations with their stems look very much like so many lilies of the valley, especially if they are viewed from the negatives stereoscopically, each having a deep, rounded, hollow depression.

Case XVII. Kidneys of lamb. They are not lobulated as the beef kidney. The pelvis is somewhat crescentic in shape. It has seven pairs of leaf-like projections in each half of the kidney proper. And each projection has a counterpart on the opposite side and is symmetrically arranged. Kidneys of dogs and raccoons bear the same fundamental structural formation as those of lambs. The only difference is in the number of the leaf-like projections. They are not so complex and subject to variations as those of the human kidneys.

Case XVIII. Kidneys of dog.

Case XIX. Kidney of raccoon.

Case XX. Kidney of pig.

Case XXI. (Fig. 10). Male: aged fifty-two. Hospital case No. 571. Clinic case No. 5452.

Specimen: *Right Kidney. Gross Description.* The specimen is a small kidney. The capsule does not strip easily. The entire kidney structure shows an increase of connective tissue. At one pole the cortex is decreased in thickness to ¾ mm. over a cavity and the inner surface at this point shows an old healed fibrous scar 4 mm. in diameter. The pelvis contains an excess of fat.

Microscopical Description. One section exhibits both cortex and medulla. In the cortex the convoluted tubules show albuminous degeneration. The medulla shows an increase in interstitial connective tissue..

In another section at one point, the capsule is thickened and degenerated. Beneath the scarred area there is a focus of parenchymal destruction with scarring of large numbers of glomeruli and diffuse round-cell infiltration and necrosis. Here there are seen a few old tubercles. In places there is marked hyaline degeneration of the interstitial tissue. The epithelium of the calyces is eroded. There is a zone of small round-cell infiltration and necrosis.

Diagnosis. Chronic pyelonephrosis; old focal tubercular infection; chronic interstitial nephritis.

No pyelography of the case was taken be-

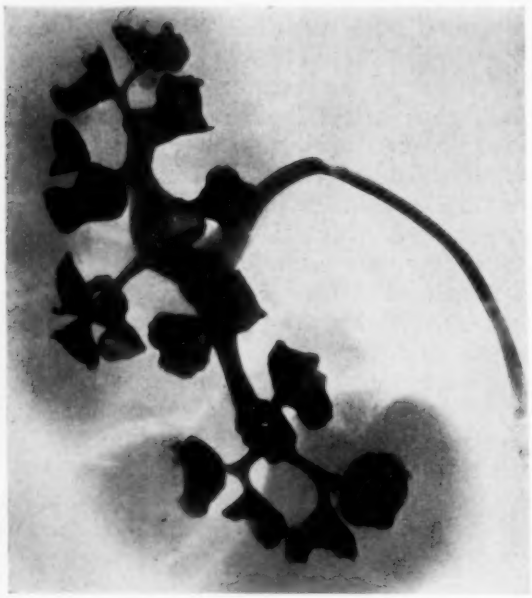


FIG. 9. CASE XIX. Beef kidney. This is to demonstrate the manner in which the major calyces branch out into secondary divisions. Each of the latter again subdivides into two, three and four minor calyces. The terminal depressions are large, deep and hollow, resembling lilies of the valley.

fore its removal. This is due to the presence of a renal calculus in the lower third of the right ureter.

The first picture of the case shows the stone in the right ureter. The second is a photograph of the kidney before injection. The third is a diagrammatic drawing of the kidney lamina as indicated by the two probes. The fourth is a drawing of the kidney after it has been sectioned, with the probe used to indicate the passage between the upper and lower pelves. The fourth is an injected picture of the pelvis, showing that there is no connection between the blood supply of the lower and the upper or supernumerary kidney. The shape of the pelvis is like a curve tube. The blood vessels seen in the smaller pelvis are those which appear superficially. They were injected because the writer thought that they belonged to the mass.

CASE XXII. Male, aged twenty-one. Hospital case No. 1541. Clinic case No. 7219.

Specimen: Right kidney. Weight 1 lb.; length 14 cm; width 8 cm.; number of renal calculi 27.

Diagnosis. Nephrolithiasis with pyogenic infection; hydronephrosis.

No pyelography was made of the case on account of one of the renal calculi completely obstructing the passage between the pelvis proper and the ureter. The first picture is a drawing of the specimen before injection and cutting it open. The second picture is a drawing with the specimen cut open, showing the renal stone lodged in the different cavities. The third picture is an *x*-ray picture of the specimen soon after its removal before injection was done. The fourth picture shows an injected kidney.

CASE XXIII. Female, aged thirty-two. Hospital case No. 5401. Clinic case No. 1501.

Specimen: Right Kidney. . Diagnosis. Chronic tubercular infection of the right kidney with marked destruction.

CASE XXIV. (Figs. 11 and 12). Girl, aged six. *Specimen: Right Kidney.* Weight 1 lb. 15.5 ounces.

Roentgenological Description of the Pel-

FIG. 10. CASE XXI. Left kidney. Supernumerary kidney. Chronic pyelonephrosis with old focal tubercular infection, and chronic interstitial nephritis. The pelvis and the blood-vessels were injected. Note the shape of the pelvis and the condition of the blood-vessels.

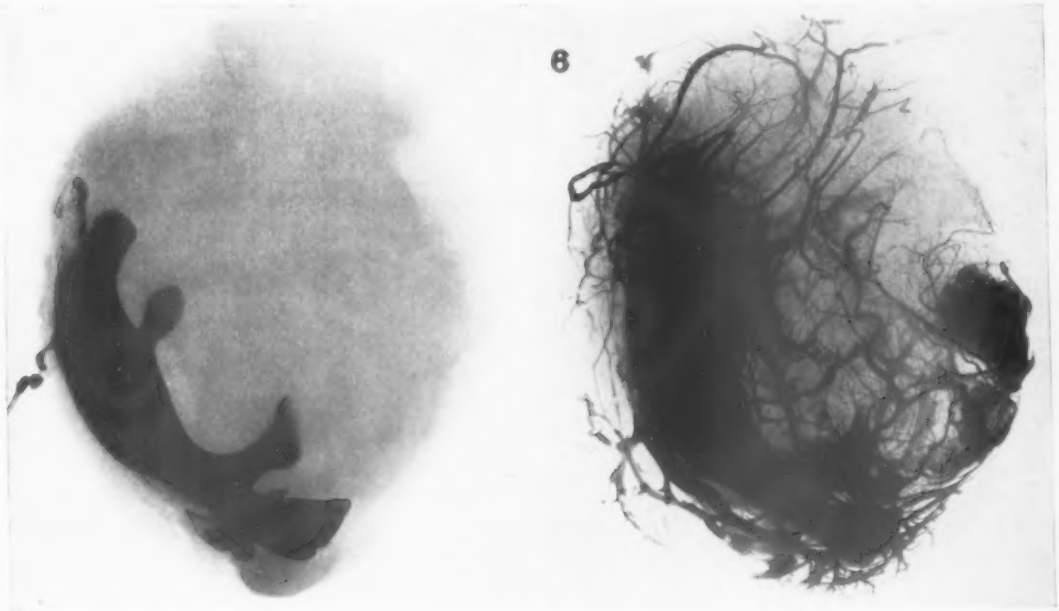


FIG. 11. FIG. 12.

FIG. 11. CASE XXIV. Pyelogram of hypernophroma. Note the seal-like appearance of the pelvis and calyces.

FIG. 12. Pyelogram of hypernephroma, the same as Fig. 11, only that in this case the blood-vessels were injected in order to demonstrate the blood supply of the tumor.

ves of the Tumor. The contour of the pelvis with its calyces resembles very much the figure of a sea lion. It is long and somewhat cylindrical. Its outline is perfectly smooth and clearly defined at all points. There is not a suggestion of haziness present. The superior major calyx, which looks like the cephalic portion of the sea lion, has only two stalky, club-shaped minor calyces. The inferior major calyx, which in turn resembles the caudal end, has also two minor calyces with broad stems and truncated apices. Its terminal portion is fan-shaped, and merges directly with the pelvis proper. The ureter, which is abnormally very small, projects abruptly from the center of the pelvis, producing a sort of valvular effect for the outflow of the pelvic contents. The blood-vessels supplying the tumor have the following peculiarities. First, they do not follow a definite coure or direction. Second, they are extremely long and tortuous. They are atypical in their arrangement. Third, they do not give the appearance of end arteries as seen in normal kidneys.

The tumor mass is not so scantily supplied with blood-vessels as is often understood. With the exception of a very small area, about 1.5 cm. in length, situated at the lower pole of the kidney, there is no normal renal tissue left. In this particular spot the course of the blood-vessels is normal, ending in end arteries.

TECHNIQUE

In order to obtain a true and undistorted shadow of the ureter, the pelvis and its calyces and the blood-vessels, it is quite necessary that the specimen should be fresh. Soon after its removal from the subject at autopsy or patient at the operating room, it is immersed in warm saline. This procedure will prevent further coagulation of the blood which is in the larger blood-vessels and capillaries.

If clotting has already taken place, injection of the vessels with saline solution becomes essential. When they are well distended and the hypodermic needle is still at the cut end, a gentle massage is applied over the specimen. This done, it is again replaced in the warm saline solution and the needle removed.

After all the blood has been removed

from the vessel, the fatty tissue of the hilus and surrounding the kidney is next removed. Here care must be exercised so that no vessels are torn and the kidney tissue injured, for the slightest injury to the parenchyma will make injection of the vessels futile.

The object in removing the superfluous fatty tissue is twofold: first, to clear the field of operation; second, to prevent the medium which may happen to escape the syringe from adhering upon them. If this is permitted to take place, when the specimen is radiographed, confusing shadow on the *x*-ray negative will result.

Before injecting the pelvis through a part of or the entire ureter, remove all the free fluid from it first. Should there be any retained fluid unremoved, it will modify the proper density of the injected medium.

In obtaining a specimen for this purpose wherever it is possible and perfectly safe, as from a subject at autopsy, the following points should be observed: first, that no injury is done to any part of the kidney perenchyma, that is the tissue continuity of the surface of the organ should remain intact. This is especially important when one wishes to inject the arteries and veins. Second, remove as much of the ureter with the kidney as possible, as this will facilitate injecting the pelvis considerably. Very frequently, in the course of injecting the ureter, air is introduced accidentally into it and air bubbles will result. A long ureter will obviate this difficulty, as the bubbles can be forced back into the ureter near the cut end. Third, ligate the larger blood-vessels as far away from the renal sinus as possible. Do not apply any traction upon them, as this will traumatize the smaller vessels in the sinus and the substance of the kidney.

In injecting a kidney in a living person a 17.5 per cent solution of sodium iodide is used. A regular cystoscopic method of procedure is employed. A detailed description of the technique is not necessary in this paper.

In injecting an extirpated kidney a plain barium sulphate suspension is used. Barium water solution seems to give the best result in this kind of work so far. It may have its drawbacks, but they are overbalanced by the results it gives upon a sensitized *x*-ray plate. Its disadvantages are:

1. If the solution is too thick, it will not only not penetrate into the finest capillary network, but it will also clog the hypodermic needle used to inject the finer blood-vessels.

2. If, on the other hand, the suspension is too thin it will not give a clear-cut shadow of the structure injected.

3. The mixture does not remain long in a state of suspension, that is, the barium settles down to the bottom of the container very readily.

To remove the first and second objections, one of the most practical means of telling whether or not the medium is sufficiently thick, is to add to the water gradually the barium sulphate, stirring it at the same time until it reaches a thickness that will pass through the lumen of a small hypodermic needle, gauge 23. Another way of preparing it is to add to every 12 ounces of barium sulphate 30 ounces of water without the admixture of acacia.

To force or inject the medium, hypodermic needles of different sizes are used, each depending upon the size and lumen of the blood-vessel and ureter.

The points of the needles are first clipped off and filed to a desired bluntness. The needle is first introduced into the lumen of the vessel or ureter, a piece of thread is tied round it, and then a luer syringe containing the medium is attached to the needle. This having been done a very slow and careful digital pressure is applied to the piston of the syringe. The pressure is immediately released the moment there is a slight resistance offered by the vessels injected. The cut end of the vessel is then tied and the needle removed. The specimen is now ready to be roentgenographed.

The writer will not go into detail as to the technique in roentgenographing the specimen, as space will not permit. The essential points only will be mentioned here. The specimen is now placed over an aluminum tunnel, and a fine focus Coolidge tube is set for a stereoscopic exposure. Very often, however, just before exposure, it becomes necessary to inject more of the medium, as some of the water will have been absorbed and the pelvis or the blood-vessel will collapse. If this has to be done, insert the needle immediately at the point nearest the tied

end into the lumen, and when the desired distention is obtained, draw the needle very carefully and apply another tie in front of the point of the needle.

Exposure technique is as follows: Fine focus Coolidge tube, current of a 5 ma., 1.5 or 2-inch spark gap, 20-inch target-plate distance, inductance 1, and 35 seconds' exposure.

CONCLUSIONS

1. A study of a series of injected normal kidney pelves enables one to get a general conception of what really constitutes normal shadow on the sensitized *x*-ray plate. He becomes prepared to meet the vagaries in the development of kidney pelvis.

2. The capacity, size and contour of the different renal pelves fundamentally may be similar, but comparatively they are dissimilar. No two pelves, not even those removed from the same subject, bear a similarity one to the other.

3. Superimposition of the minor calyces upon the isthmus throws a shadow which very often simulates renal calculi.

4. Distended renal blood-vessels, especially the arteries, which happen to cross the pelvis, the isthmus and the calyx, affect the contour of these structures, giving them a distorted and abnormal shadow.

5. In four kidneys removed from two subjects, aged eight and twelve respectively, there is present a constant tortuosity at the ureteropelvic junction.

6. The number of minor calyces springing from one major calyx ranges from one, and even a complete absence of, to seven and eight. The inferior major calyx as a rule has a greater number of minor calyces than the superior.

7. The middle major calyx, generally, is very small, springing from the pelvis either in a diminutive form or branching out as a part of the inferior major calyx.

8. The pelves of lower animals show a more primitive stage of development. They are simpler and more symmetrical in their formation.

Note. The writer wishes to express his great indebtedness to Dr. Alexander W. Blain and Dr. Ira G. Downer for their staunch support from the beginning of the investigation work. To Dr. Paul Eisen and Dr. Leo E. Grajewski he owes much for their invaluable suggestion. His thanks are also due Dr. James E. Davis, Professor of Pathology of the Detroit College of Medicine and Surgery for the careful pathological studies. The drawings are the work of J. H. D. Ferguson, artist of the Department of Medical Research of the Jefferson Clinic.

DISCUSSION

DR. LIM. In regard to Dr. LeWald's question on technique of injection, not wishing to go into detail, I will say that we use simply plain barium water, that is, plain water and barium sulphate. No acacia is used. We have tried acacia with barium water, but it proved a failure, because it was too thick. We use only digital pressure, and the pressure is released as soon as there is a certain degree of resistance offered. No mechanical pressure at all is used. A little practice will give one the desired results. Hypodermic needles of the finest caliber are used for the smaller arteries and stub-pointed needles for the larger vessels and ureter.

We find so far in the work that barium water serves the purpose very well indeed. However, we will not stop here, but will go further in the use of other media. It has been suggested that possibly red lead might do, but we have not as yet tried it. Reasons again for using plain barium suspension are that the pathological specimen is not destroyed by this medium, for it can easily be washed off after the specimen has been injected, and that does not stick and glue together as do bismuth suspension and some other media.

A REVIEW OF THREE YEARS' WORK AND ARTICLES ON PNEUMOPERITONEUM*

By JAMES T. CASE, M.D., F. A. C. S.

Surgeon and Director Radiological Department, Battle Creek Sanitarium.

BATTLE CREEK, MICHIGAN

IN accepting the task imposed on him by our president, your essayist finds himself in a more or less embarrassing position in undertaking to sum up the present status of artificial pneumoperitoneum as a diagnostic aid. It is universally conceded that the development of this diagnostic procedure, so brilliantly perfected by Stein and Sewart, marks one of the milestones in roentgenological progress. In reviewing the results of the experience of most of the men doing this type of diagnostic work, including several who are not members of this society, your reviewer does not wish to perhaps discourage the employment of one of the most strikingly helpful roentgenological means perfected within five years; neither by maintaining a discreet silence can he conscientiously withhold information relating to some phases of danger associated with the method.

In the effort to study the question from an unbiased point of view, gathering data from every available American source, circular letters of inquiry were prepared and sent to 223 workers, from whom 131 replies were returned. Of the 131 replying, 47 (among whom were included the names of some of the most prominent members of our society) stated that they had had no experience, while 63 more declared that their experience was too limited to warrant an expression of opinion. Twenty-one had had sufficient experience to enable them to formulate replies to the inquiries regarding dangers, inconveniences and contraindications, and to sum up their notion of the field of usefulness of pneumoperitoneum. Special inquiry was made concerning the safety of this measure as an office diagnostic procedure.

It seems generally agreed that the method must be pursued with due regard to the necessities of an aseptic surgical operation, excluding from the examination such cardiac or respiratory cases as would ordinarily be considered bad surgical risks; that the gas used should be carbon dioxide or a mixture of carbon dioxide and oxygen; that the amount of gas introduced should be carefully estimated; that the injection be done slowly, while the patient is carefully observed for signs of untoward effect. And indeed a review of the experience of the men who have answered the questionnaire warns of the serious dangers and inconveniences if these precautions are not followed, if indeed serious mishaps may not occur in spite of all precautions.

INCONVENIENCES

It seems unanimously conceded that pneumoperitoneum is not a popular procedure with the patients. It is true that the distress seems to be largely psychic in many cases, but too often the pain is very real, requiring the administration of morphia. Many of the patients complain of nausea; some vomit. The majority show respiratory distress evidenced by dyspnea and a feeling which they describe as shortness of breath. Some patients sweat profusely after the examination. When carbon dioxide has been used, it is true that the symptoms are usually dissipated within a few hours, although it is not uncommon to note their persistence long after the distention of the abdomen has been relieved. Certainly no patient thus examined recalls the experience as pleasant. There is a further objection that the method is time-consuming, and the cause of considerable inconvenience in the roentgen laboratory.

It should be stated that there is a marked difference between the discomfort experienced by the patient when only a small amount of gas has been introduced into the peritoneal cavity, as in the method advocated by Rubin and Peterson, where the chief aim of the study is to determine the patency of

*Read at the Twenty-Second Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Washington, D.C., Sept. 27-30, 1921.

the tubes and other data relating to the pelvic organs, in comparison with the distress experienced after massive inflation of the abdomen for the purpose of general abdominal diagnosis.

Aside from the distress, the list of inconveniences which we have been able to enumerate seem to be dependent upon errors of technique which it should be possible to avoid, but which experience shows are not always avoided, even in the best clinics: viz., interstitial emphysema, which may naturally be avoided by making sure that the needle is within the abdominal cavity before turning on the gas; sudden overdistention, not likely when gas measuring devices are employed; persisting overdistention, usually, but not always, relieved by deflation, or better still by the employment of carbon dioxide in place of oxygen.

Yet several of our reporters state that they have had patients whom they could not deflate, and where the pain following the examination could not be controlled by large doses of morphine. These patients, it appears, were for the most part suffering from peritoneal adhesions. Certain it is that the patients complaining the most bitterly of pain have been patients in whom the presence of adhesions seemed indubitable. Many patients whose examination has later been followed by operation, have expressed the opinion that the discomfort experienced after operation was more easily borne than the distress attending gas inflation of the abdomen.

DANGERS

Dangers which have been enumerated include the following: Intestinal puncture; puncture of omental or mesenteric blood vessel; puncture of dilated ureter, bladder, or other abdominal viscus; peritonitis; air embolism; superficial emphysema; rupture of malignant adhesions; precipitation of cardiac failure through overdistention of the abdomen. Practically every one of the dangers just enumerated has been foreseen, and the pioneers in pneumoperitoneum have made rather thoroughgoing experimental observations in the effort to predetermine the amount of danger actually imposed upon the patient. At first, it seemed fairly assured that such untoward effects were not going to be encountered; but gradually reports have been coming in until now we have accumulated an impressive list of accidents which have actually occurred in the hands of men for the most part recognized as well qualified by training and equipment to do this work properly. The dangers, as above listed, together with remarks concerning them will follow seratim.

Intestinal Puncture. In at least one case the intestine was punctured and gas introduced into the small intestine in a patient who had not had any previous surgery, and in whom there was no reason to suspect adhesions of the intestine to the anterior abdominal wall. Fortunately the introduction of gas in this case was proceeding under fluoroscopic control; the fact of intestinal puncture was almost immediately recognized, and the needle withdrawn instantly. No untoward effects resulted in this case, though the patient was kept in bed for three days, under careful observaton. Another case is recorded where the puncture of adherent intestine was proven by the beautifully outlined air-distended colon shown in the roentgenogram, without the usual evidences of gas in the peritoneal cavity. Another reporter related a case where colon was adherent to the abdominal wall from cecum to splenic flexure, the adhesions also involving several loops of jejunum. The needle entered the lumen of the intestine and great distress followed. Details as to the nature of the complications were not given. It is without doubt possible to puncture the bowel during the introduction of the needle, though the writer has yet to learn of a fatality from this cause.

Puncture of Omental or Mesenteric Blood-Vessel. The possibility of this danger is often mentioned. One reporter states that in a great many laparotomies a needle was inserted before the abdomen was opened. In one case, it was found that from one of the mesenteric vessels, there had occurred a fairly large hemorrhage which might have given some trouble if the abdomen had not been opened within a short time.

Puncture of Abdominal Viscera. In a discussion on a paper before the Section on Urology at the last meeting of the American Medical Association, Sante relates a case

of death following an attempt at pneumoperitoneum, death being due to the injection of oxygen directly into the spleen. As the reporter stated, this case was manifestly an error; but these errors should be reported, and should be taken into due consideration in appraising the value of the procedure. The urinary bladder has been punctured at least once. In another case, in the hands of a well known urologist, an examination was being conducted in a case where no special tests were needed to recognize an enormous hydro-ureter. The urologist thought it would be unique to procure roentgenograms of this case after distending the peritoneum with gas; but, although an experienced surgeon introduced the needle far to the opposite side of the midline, fully confident that he would avoid puncture of the urinary system, he evacutated several pints of urine through the pneumoperitoneum needle. No harm resulted, for which all concerned were duly thankful; no one would knowingly repeat the experience.

Peritonitis. Barringer, of the Memorial Hospital, New York, is responsible for the report of one fatality following air inflation of the peritoneum in a patient with carcinoma. The injection was made with all due regard for asepsis, but some days after the injection the patient died. Dr. James Ewing, who performed the autopsy, reported a generalized peritonitis, the infection manifestly entering by way of the needle. It was admitted that this patient, because of his advanced carcinoma, was probably peculiarly susceptible to infection.

One of the senior surgeons in the largest surgical clinic in the world recently published a statement that wound infection occurred in about ten per cent of their clean wounds, and this in spite of every precaution known to science. It is presuming too much to expect that abdominal puncture for pneumoperitoneum can proceed month after month in scores of cases, without sooner or later recording more than one instance of peritonitis.

Even with the employment of the transuterine route there is danger of waking up latent infection and the cases must therefore be carefully selected. One case is reported wherein a young married woman, in whom a careful history and examination by the gynecologist gave no sign of tubal infection or obstruction, transuterine pneumoperitoneum revealed patency of at least one tube and a left ovarian cyst. A laparotomy was performed the following day for removal of the dermoid, the tubes and remaining ovary being noted as normal. Two days later the patient developed a definite right salpingitis with, shortly after, extension to the left tube, followed by prolonged and painful convalescence.

Air Embolism. This is a real danger. At least one death and probably two, may be thus explained. These cases are briefly related in a later paragraph recounting the known deaths in conection with this method of diagnosis. Another case is reported in which death was escaped by a narrow margin, where it is reasonable to believe that there may have been a small amount of air injected into a vein. It is now recognized that a small air embolism may not prove fatal or even cause any symptoms; however, none of us cares willingly to permit such an injection. If one takes the precaution to make sure that no blood escapes from the cannula after removal of the trocar, there will be little danger of this accident.

Superficial Emphysema. This is a distressing and confusing accident—confusing so far as the diagnostic value of the resulting roentgenograms is concerned—but no case has been reported in which harm has resulted. Of course, this is also a fault in technique but its occurrence is confessed by some of the men with the largest experience in this method.

Rupture of Malignant Adhesions. It is conceivable that abdominal overdistention might tear loose some types of malignant adhesions and thus awaken renewed virulence in some more or less latent malignancy. This danger is mentioned by a number of our reporters, in the hands of one of whom this sequence of events was followed by a rapidly fatal outcome. The writer is not inclined to consider this danger as a serious drawback to the method.

Precipitation of Cardiac Failure. This rather serious danger is a real one. One of our most enthusiastic advocates of pneumoperitoneum has suspended the employment of this procedure because of a near fatality in a case of this sort. The patient was a well pre-

served man of sixty who was very anxious to determine whether or not he had gall-bladder disease. A few moments after introducing the usual amount of CO_2 the patient became exceedingly distressed and markedly cyanotic, his pulse was imperceptible, and no heart-beats could be heard with the stethoscope for a period of several minutes. It certainly looked as if the man were dying, but he recovered during the next twenty minutes. He was rather groggy for the rest of the afternoon, but this may have been due to the morphine which he received before the work began. The man possessed a very nervous make-up, but his blood pressure was normal and his heart appeared to be normal. The physician discovered later that on two or three occasions the patient had had sudden attacks of syncope during which he became unconscious and during which he vomited. Nevertheless the experience was so harrowing, our reporter felt that he would not care or dare to run the risk again unless the experience of many others showed the technique to be as safe as it had seemed to him in the past.

Another reporter related a case when with only the usual amount of abdominal distension, the exact measurement of the quantity of gas not being recorded, a woman patient went into a state of profound shock, from which she was revived only after an afternoon and night of anxious effort.

It is obvious that cases of inefficient myocardium, valvular heart lesion or other cardiovascular weakness should only exceptionally be subjected to this method of study.

DEATHS

Four deaths, directly associated with pneumoperitoneum have come to your reviewer's notice. Two have already been related, one due to introduction of oxygen into the spleen, and one due to peritonitis. Two further cases will now be related under this miscellaneous heading, inasmuch as there is some difference of opinion as to the exact cause of death, though both are undeniably associated with an attempt to examine by the pneumoperitoneum method.

The first of these two cases comes from one of the best known medical institutions in the world, where it cannot be doubted that all reasonable precautions were taken to avoid danger to the patient. A young woman of thirty-five had undergone a very thorough clinical study of her case to discover the cause of weakness, loss of appetite, headache and enlargement of the abdomen. A mass could be seen and palpated in the epigastric region reaching below the umbilicus, more marked on the right side. It was irregular and hard to palpation, and rather tender. The liver edge was felt 4 cm. below the costal margin; the spleen was not palpable. Pneumoperitoneum was proposed and carried out half an hour after the hypodermic injection of morphine 1/6. A small amount of novocaine, ½ per cent strength, was used for local anesthetic. The skin was incised with a scalpel and a small needle introduced into the free peritoneal cavity. Oxygen and CO_2 bubbled through sterile fluid in a bottle fitted with a three-way stopper. The gas had just started to bubble through the fluid, only a few c.cm., when suddenly the patient became cyanotic and the hands, especially the left, went into the position of tetany, whereupon the needle was immediately withdrawn. The pulse became extremely weak and could not be felt at the wrists. The heart sounds slowed to 30 or 40 per minute, as heard with the stethoscope, and were much weakened. Respiration practically ceased. Artificial respiration was given as well as atropin and adrenalin intravenously. After twenty or thirty minutes, the heart rate would suddenly jump to 130 or 140; then suddenly drop to about 40. There was gradual improvement in respiration and heart rate until at the end of an hour the pulse was 120 and respiration 18 to 20. The patient was not conscious. After four hours the pulse was 102, with some extra systoles, respiration 30, temperature 99. Occasional movements of arms and eyelids were noted but no return to consciousness. On the following afternoon, the pulse averaging 100 to 110, respiration being fairly normal, the patient suddenly experienced an attack similar to the one of the previous day. She became cyanotic, the pulse failed at the wrist, respiration ceased, and the end came very quickly, just twenty-four hours after the attempt at pneumoperitoneum. No post mortem examination could be obtained. At the time the normal rhythm was resumed, about two hours after the examination was

started, there was heard a most unusual sound over the base of the heart, characterized by the clinicians as a gurgling, loud systolic sound, very superficial, just "under the ear". This continued for 15 to 20 beats, grew gradually fainter, and then disappeared. The final diagnosis was: Possible air embolism, gumma of the liver. Simple heart block would not explain the continued unconsciousness after the resumption of normal rhythm.

The fourth fatality of which I have record occurred at the beginning of an injection for the performance of artificial pneumoperitoneum. The patient, sex not given, was fifty years old, with a clinical diagnosis of splenic leukemia. Gastrointestinal study by the barium meal showed the stomach displaced slightly toward the median line by a mass in the left upper quadrant of the abdomen, probably splenic. It was decided to do a splenectomy. Artificial pneumoperitoneum was requested to determine the presence or absence of adhesions between the spleen and the diaphragm. The patient was prepared in the usual manner, and the surgeon inserted the paracentesis needle. Oxygen was employed. In less than one minute after the gas was turned on the patient suddenly became cyanotic and unconscious. Respiration was stopped. The needle was at once withdrawn but in spite of every effort the patient died within five minutes of the time of the insertion of the needle. The quantity of gas which had passed into the peritoneal cavity was very small—so small that no distention was noticeable. The needle had been passed by a surgeon who had done a number of injections previously. Here too, unfortunately, the exact cause of death was not determined. The reporter of this case felt that it was not due to any factor pertaining to the procedure itself, but rather to a cause which might have been active during the course of paracentesis abdominis for any other purpose. The surgeon had observed in this case that the patient was extremely apprehensive and fearful on entering the hospital that morning. Clinical examination revealed no evidence of serious cardiac derangement prior to the attempted pneumoperitoneum; the patient was ambulant up to the time of his entering the hospital. In your reviewer's opinion, this case is exactly analogous to the preceding.

There were probably other deaths to report in this connection, for two of the four just recited were stumbled upon from sources other than those circularized. They furnish abundant food for thought, and incontestably mark the procedure of artificial pneumoperitoneum as one which should be performed only in an institution fully equipped for surgical operations and emergencies, by men ready to assume at once the responsibilities of dealing with such emergencies should they arise. It is interesting to note that in three exactly similar accidents, two of them fatal, characterized by sudden cyanosis, unconsciousness, suspension of respiration and alarming cardiac disturbance, oxygen was used in one, carbon dioxide in another, and a mixture of carbon dioxide and oxygen in the third.

It is only fair in this connection to recall the dangers associated with several other established diagnostic means such as spinal puncture and pyleography. Neither of these is an absolutely safe procedure; accidents have been recorded with both, and possibly some fatalities. Both procedures are often followed by unpleasant experiences on the part of the patient. Neither of them is performed as a routine examination, nor are they recommended without due consideration of the contraindications, and the real necessity for their employment.

However, the fatal or alarming attacks above related in connection with attempted pneumoperitoneum have a striking similarity in the details of their symptoms and in the lightning rapidity of their onset; and few of us will be able to assist at future examinations by this method without a vivid consciousness of the possible dangers.

Undoubtedly some of the accidents above recited are the result of errors in technique; yet these errors have occurred in some of the foremost medical and surgical clinics of the world, in the hands of men recognized as able to avoid such errors if indeed it is possible always to avoid them. We may therefore assume that such errors are likely to recur from time to time in spite of all our foresight and precaution.

INDICATIONS

In general, it may be stated that pneumoperitoneum is definitely indicated in a se-

lected class of cases of obscure abdominal or retroperitoneal conditions, where the careful use of all other clinical means has failed to elucidate the problem with any degree of satisfaction and where an exploratory operation does not seem preferable. Such conditions relate especially to lesions of the diaphragm other than subphrenic abscess, and obscure retroperitoneal lesions. Certain lesions of the kidney and their differentiation from paravertebral masses are especially illuminated by this method, but the opinion is frequently offered that where the method has been used in urological work, it has only occasionally added to the data already secured by other roentgenological or urological diagnostic means. The perfection of the Potter-Bucky diaphragm has been one of the most important factors in still further narrowing the field of usefulness of pneumoperitoneum, for good roentgenograms made with the Potter-Bucky diaphragm show a wealth of detail only surpassed by plates made after gas inflation of the abdomen. Many laboratories have adopted the plan of trying the Potter-Bucky diaphragm technique before resorting to pneumoperitoneum, with the result that the latter is frequently not needed.

Abdominal ascites presents the least contested indication for the introduction of gas, which is so easily and safely carried out in this type of cases. The method is probably next most useful to the gynecologist, especially when minimal amounts of gas are introduced by transuterine insufflation.

Abdominal adhesions at first seemed to offer the most tempting indication for pneumoperitoneum, especially that class of cases where the patient developed a clinical picture not present before operation. But postoperative adhesions are very common; probably a very small proportion only cause symptoms which bring the patient to the roentgenologist. When a patient develops a new train of symptoms following abdominal section, the surgeon is frequently assured, without special roentgenologic study, that adhesions are responsible; but the only type of adhesion for which he is likely to operate are those involving attachment of the small intestine to the abdominal wall or to some fixed viscus. Adhesions of intestine to the abdominal wall are sometimes most strikingly demonstrated by pneumoperitoneum.

The question may properly arise whether it is not possible to go too far in our effort to complete a diagnosis; and whether there does not remain a certain field for the exploratory operation. Your reviewer realizes that he has stood in a difficult position in making this appraisal of the value of pneumoperitoneum. It is hard to subtract the individual factor and make the appraisal impersonal. The opinions expressed are distinctly not original in your reviewer's mind, although he finds himself in accord with them; they are gleaned from hundreds of pages of correspondence with men of large experience most likely to be able to furnish information.

DISCUSSION

Dr W. H. Stewart. We are grateful to Dr. Case for gathering all of this interesting data. Unfortunately, our President has selected a man to obtain this information who, we feel, is distinctly surgical in his tendencies. We all recognize his ability as a surgeon, as well as a roentgenologist. It has been difficult to convince a certain class of surgeons throughout the country as to the practical value of pneumoperitoneum. We fear Dr. Case comes within this class. One can freely say, however, that he has treated the subject in a fair manner.

It must be remembered that we have had many difficulties in placing this method before the medical profession of this country. The same difficulty was met with when spinal puncture was introduced; this has been overcome and we feel the prejudice against pneumoperitoneum will, in a great measure, disappear.

If we accept a mortality of four cases since the method was introduced, one can be quite satisfied, considering the number of patients that have been examined and also the fact that in many instances the inflation had been performed by the inexperienced. We are accustomed to surgical mortality, but death from any new procedure is not accepted so readily. It is difficult to appreciate a death from puncture of the spleen or from infection, if proper surgical precautions are used. Unfortunately the post-mortem findings could not be obtained in the other two cases, one can, therefore, never feel sure that pneumoperitoneum was the cause of death.

In advocating this procedure, we have always warned against its indiscriminate use. The inflation should be done by a surgeon and

not by a roentgenologist, unless he has had special surgical training, and the method should never be used except in cases where the information cannot be obtained by the ordinary methods of examination.

We have never felt that it was necessary to measure the gas; one must use judgment as to the quantity. Relaxation of the abdominal walls prevents a uniformity to the dose, and massive inflation is not advisable; not much gas is needed. At first, when oxygen was used, we distended the abdomen to a considerable extent; this we have since found is unnecessary. The abdomen should be distended to a full dome shape, and with the least possible amount of tension. The more the abdominal cavity is distended, the more danger of pain and dyspnoea. Since we have been using morphine with carbon dioxide, the patients have had very little pain or distress. In all of our series, over one hundred and fifty, we have never had one with any serious trouble.

We have never considered the danger of puncturing the intestines, owing to the fact that if one goes about 3 cm. below the umbilicus, he will never have any difficulty, especially if the abdominal wall be somewhat relaxed, and can be raised from the intestines.

While in Germany this summer I had the pleasure of hearing a paper by Goetze, who is probably one of the most ardent advocates of the method. He turns the patient on the side and punctures in the left or right iliac fossa.

Dr Case (closing the discussion). I did not choose this subject and I do not want for a moment to give the impression that I am trying to kill the method. I consider artificial pneumoperitoneum one of the most brilliant accomplishments in the last five or six years of roentgenological development. It has a very definite field. I expect to go on using it for a certain number of cases. These instances, however, will be puzzling cases involving the diaphragm (where this method has its supreme value) and in the study of retro-peritoneal masses. A very helpful point of technique in the latter type of case is to put the patient in the knee-chest position, after the introduction of gas, thus allowing the intestines to fall away from the spine. The lateral roentgenogram made under these conditions is strikingly helpful, as has been especially demonstrated by Sante.

Dr Stewart is mistaken; there were five deaths, but he admitted only two. It is hard in one of these pneumoperitoneum cases to convince the hospital staff or the patient's family that death was not due to the pneumoperitoneum. In three of the cases surgeons did the pneumoperitoneum; in another an interne did it.

I used the term "massive inflation" in contradistinction to the term introduced by Rubin of "minimum" or "minute" inflation. It is not necessary to pass more than a small quantity of gas through the uterus. By massive inflation I meant the term as Dr. Van Zwaluwenburg used it.

A member of our society introduced the use of CO_2; used it in a very large number of cases; then reported a near-fatality and now declares he will not use the method again until it is demonstrated safe to use it. Recognizing the dangers, I personally expect to go on using the method in a limited way. It is not my purpose to say we should not use it. I simply call attention to the dangers. The roentgenologist must protect himself by having the inflation done in an institution and by recognizing the limitations of the method. It was suggested by one member of our society that the use of pneumoperitoneum, or rather the frequency of its use, will be in inverse proportion to the degree to which other clinical means have been exhausted.

Comparing exploratory operation and pneumoperitoneum, exploratory operation is usually done under a local or gas anesthetic. It is not a serious affair provided nothing more is done than to explore, and we are considerably more sure in our diagnosis than by pneumoperitoneum. There is a certain amount of pain, for which we give morphine; that is done in pneumoperitoneum. Half a gram altogether is the maximum I ever give to a patient; usually less. When using gas anesthetic, 50 per cent are not nauseated; using local anesthetic, there is no occasion for any nausea. In exploratory operations I do not think there should be more than ½ per cent mortality, and that should not occur in purely exploratory operations.

The exploratory operation has a distinct advantage in that after you have made your diagnosis you will, in a large per cent of cases, go ahead and attend to it without subjecting the patient to further mental or physical discomfort.

I would like to ask Dr. Van Zwaluwenburg one question. We will admit difficulty in making a correct gynecological diagnosis in heavy patients. Naturally the use of pneumoperitoneum is invoked as a means of eliciting a diagnosis. How many times has he observed surgeons leave a pelvic pathology in the pelvis, whether they found their diagnosis was correct or incorrect? In other words, it matters little,

as far as the surgical indication is concerned, whether we differentiate between a tubal or an ovarian mass in the great majority of cases.

I would like to suggest that the term "exploratory operation" be not used. We call it surgical examination. Surgical examination does not promise the patient anything (neither does pneumoperitoneum) in the way of relief.

I want to reiterate that there is a definite field for this pneumoperitoneum work. I want to emphasize the use of the Potter-Bucky diaphragm, which will obviate the necessity of pneumoperitoneum in a large percentage of cases.

OBSERVATIONS ON THE NORMALLY DEVELOPING SHOULDER*

By ISIDORE COHN, M.D., F.A.C.S.

Professor Clinical Surgery, Tulane University;
Associate Senior Surgeon, Touro Infirmary

NEW ORLEANS, LOUISIANA

THE study of the shoulder has been carried out in a manner similar to the studies made on the elbow and knee.

One is encouraged to continue these studies by such quotations as the following taken from an article by Bowen.[1]

"Experience leads me to the belief that clinically, actual diagnosis of separation of an epiphysis, as distinguished from a fracture is practically unusual. Given a fracture close to an epiphysis, one may, with the patient's age known, make a shrewd guess."

A tribute is paid to the work of Poland which the author says is remarkable for its completeness. This work which should have been so useful is now out of print.

The study has been divided into three parts:

(1). A review of the literature.

(2). Observations based on a study of normal shoulder joint.

(3). Descriptive findings of individual radiograms of normal joints at various ages.

PART I

REVIEW OF THE LITERATURE

It is not necessary to review again the general literature of epiphyseal separation as this was done in the original paper.[2]

Piersol, in his work on anatomy states: "There are two or three (centers) for the upper, a chief one for the head coming soon after birth and sometimes sooner.

"In the third year ossification begins in the greater tuberosity, and another point may appear somewhat later in the lesser one.

"At five all of the centers for this end may become one, making a cap for the top of the shaft, which later extends into the head. The upper end joins at about nineteen, the line of union being lost at twenty or twenty-one."

Gray's "Anatomy" gives the following: "During the first year, sometimes before birth, ossification commences in the head of the bone and during the third year the center for the tuberosities makes its appearance, usually by a single ossification point, but sometimes, according to Beclard, by one for each tuberosity, that for the lesser being the smaller and not appearing until the fifth year." "By the sixth year the centers for the head and tuberosities have increased in size and become joined, so as to form a single large epiphysis."

"The upper epiphysis is not united until the twentieth year." Preston's work on fractures[3] is in complete agreement in word and sentiment with Gray's "Anatomy."

Stimson states: "The upper *epiphysis* of the humerus comprises the head and the tuberosities."

*I wish to express my appreciation of the kind cooperation and assistance in this work of Drs. Paul G. Lacroix and I. M. Gage of the surgical staff of Touro Infirmary, as well as to Drs. Samuel and Bowie of the Department of Radiology. Particular mention should be made of the splendid cooperation and interest in the work manifested by Mr. Goodman, technician in the Department of Radiology.

Comment. It is interesting to note that Stimson speaks as though he believed that there was a single epiphysis.

Cotton does not venture an opinion on the subject under the heading "Separation of the Epiphysis" (humerus) in his work on "Dislocations and Joint Fractures."

In Morris's "Anatomy" we find: "Single centers appear for the head in the first year, for the greater tuberosity in the third year and for the small tuberosity in the fifth year, though sometimes the latter ossifies by an extension from the greater tuberosity. These three nuclei coalesce at six years to form a single epiphysis which joins the shaft about the twentieth year."

Lewis's Gray and Spitzka's "Anatomy" as well as Gerrish's "Anatomy" agree in every detail with the above.

Cunningham[4] states: "Within the first six months after birth a center usually appears for the head; this is succeeded by one for the greater tuberosity during the second or third year. These soon coalesce and a third center for the small tuberosity begins to appear about the end of the third year or may be delayed until the fourth or fifth year.

These three centers are all blended by the seventh year and form an epiphysis which ultimately unites with the shaft about the age of twenty-five."

According to Eisendrath[5], "The upper epiphysis joins the shaft at the age of twenty."

Williams[6] in a chapter on "Development of the Skeleton" does not mention particular ages at which union of the epiphysis and shaft takes place. No pictures are given. Von Bergmann, Senn, Park and many other recent standard works on surgery were consulted for information and nothing was found that would be helpful on this subject.

Choyce gives the following: "The upper end of the humerus is formed of three separate epiphyses, for the head and greater and lesser tuberosities, the centers for which appear respectively at six months, two years, and three years after birth. They are all united at the end of the second year to form a single epiphysis which joins the shaft, at the age of twenty-five.

Roberts and Kelly state: "The humerus is developed from a center of ossification for the diaphysis, which appears during the eighth week of fetal life, and six or seven secondary centers for the extremities which appear after birth, the epiphysis being cartilaginous. During the first year the centers appear in the following order:—upper epiphysis for the head, the capitellum, the greater tuberosity, the lesser tuberosity, the trochlea, the external and internal epicondyles, which appear between the tenth and twelfth years. Complete ossification and disappearance of the synchondroses from the twentieth to the twenty-second year."

PART II

OBSERVATIONS

When examining roentgenograms of the shoulder in the young, one must know how many separate epiphyses are normally present, when each one begins to ossify and when complete ossification and union take place.

Pictures of the shoulder girdle include the upper limit of the humerus, the scapula, and the clavicle.

We have observed one definite epiphysis for the upper end of the humerus and possibly a second, corresponding to the greater tuberosity of the humerus and one for the acromion process.

The earliest observation which we have made is at the age of seven weeks; at this time there is only one epiphysis, which corresponds to the head of the humerus; this is elliptical and it is rather widely separated from the upper limit of the shaft, which resembles a double inclined plane. At this time the glenoid fossa, the acromion process and the clavicle are ossified in the same degree as the diaphysis of the humerus. There is no evidence of the coracoid process at this time.

During the first two years no other epiphysis appears to be ossifying. The epiphysis for the head almost doubles its size and approximates more closely the shaft. There is at this time a small shadow representing the ossifying coracoid process.

At three years of age the upper epiphysis has increased very much in size and a new shadow is seen to the outer side of the original elliptical shadow for the head, the new shadow being a smaller ellipse than the ori-

TABLE I

OSSIFICATION IN UPPER EPIPHYSIS

Author	*Head*	*Greater Tuberosity*	*Lesser Tuberosity*	*Union with Shaft*
Piersol	Soon after birth (At five all	Third year have united to form	Later than third year one epiphysis)	Twenty to twenty-one
Gray	During first year (All coalesce to epiphysis)	Third year form a single	Third year. Sometimes as late as the fifth or sixth year.	Twentieth year
Morris	First year (All coalesce to epiphysis at six)	Third year form a single	Fifth year. Sometimes this is an extension of the greater tuberosity.	Twentieth year
Lewis Gray Spitzka Gerrish	Same as above			
Cunningham	During first six months	Second or third year	Third to fifth year	Twenty-five
Eisendrath				Twenty
Choyce	All unite by the Three separa Six months	second year te epiphysis Two years	Three years	Twenty-five
Preston	Gives the same as Gray's "Anatomy."			
Roberts and Kelly	First year	First year	First year	Twenty to twenty-two
Cohn	Radiologically there is only definite epiphysis. Ossification is certainly evident at seven weeks after birth. Complete union with the shaft takes place between the nineteenth and twentieth year. The greater tuberosity seems to be a downward growth from the head. In none of our pictures have we been able to see a separate center of ossification for the lesser tuberosity.			

ginal. It is difficult to say whether this represents ossification within a separate center or whether it is a downward and outward growth from the head. In either event the cap formed by the above described shadow forms a groove and tongue joint with the shaft. The coracoid has now become a distinct shadow.

Few important changes in general are evident until the seventh year; at this time the upper epiphysis for the head and the greater tuberosity are certainly one.

By the eighth year almost complete ossification has taken place in the epiphysis and we find it closely approximated to the shaft. The coracoid has also increased greatly in size.

A peculiar picture is presented at nine years and ten months (Fig. 10). Examining it carefully one finds that there is a constriction below the head and lower down on the picture, there is a definite wedge-shaped "fragment". It was difficult to interpret this particular appearance until it was realized that possibly it might be due to two things, position and an optical illusion.

In order to determine if the apparent lines were due to position and nothing else it was determined to take the same shoulder in several positions. These proved conclusively that the appearance is an optical illusion, the result of looking through the epiphysis at different angles (Figs. 20, 21 and 22).

From this age until nearly the fifteenth year few changes are noted, except a progressive enlargement and ossification of the epiphysis.

At the age of fourteen years and six

FIG. 1. Normal shoulder. Age: 7 weeks.

FIG. 2. Normal shoulder. Age: 5 months.

FIG. 3. Normal shoulder. Age: 5 months.

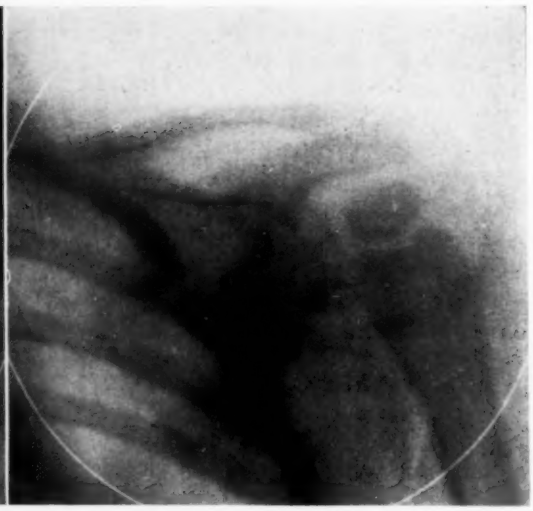


FIG. 4. Normal shoulder. Age: 13 months.

FIG. 5. Normal shoulder. Age: 2 years.

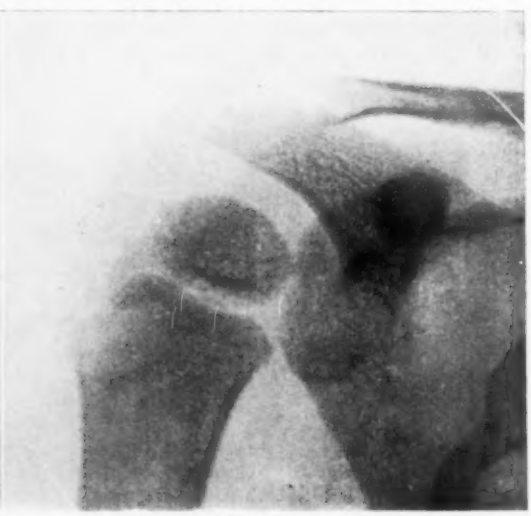


FIG. 6. Normal shoulder. Age: 3 years.

FIG. 7. Normal shoulder. Age: 4 years, 7 months.

FIG. 8. Normal shoulder. Age: 7 years.

FIG. 9. Normal shoulder. Age: 8 years.

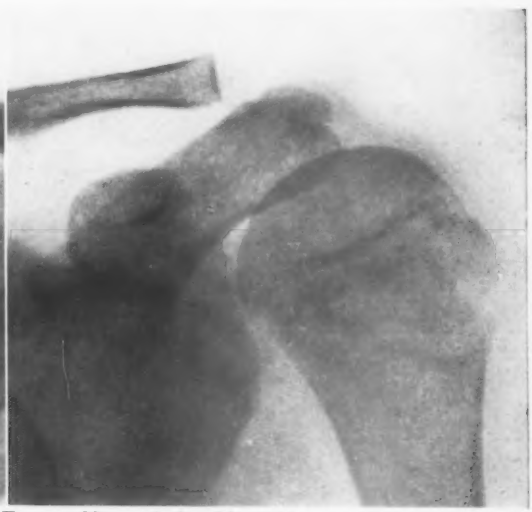


FIG. 10. Normal shoulder. Age: 9 years, 10 months.

FIG. 11. Normal shoulder. Age: 11 years, 6 months.

FIG. 12. Normal shoulder. Age: 14 years.

months we note a definite center of ossification for the acromion process. This is very important because this epiphysis is often mistaken for a fracture. At this time also we note that the greater tuberosity of the humerus shows a distinct line which might be mistaken for a fracture (Fig. 14).

At the age of eighteen years and seven months (Fig. 18) all of the epiphyses are united to the shaft—there being only the slightest line of demarcation at the lower level of the greater tuberosity of the humerus; this line is irregular and may extend through the diameter of the shaft.

By the twentieth year all of the epiphyses are completely ossified and the shoulder has the appearance of the adult normal type.

PART III

INTERPRETATION OF NORMAL SHOULDER PICTURES AT VARIOUS AGES

Age: *Seven Weeks* (Fig. 1). At this time there is one epiphysis for the upper end of the humerus and this is a small elliptical mass widely separated from the shaft. The acromion process, the glenoid fossa and the clavicle are all well ossified. There is no evidence of a coracoid process.

Five Months (Figs. 2 and 3). The only change that is noted is a marked increase in the size of the upper epiphysis, which is now at least twice the size of the same shadow at seven weeks.

Thirteen Months (Fig. 4). The upper epiphysis has increased in size. No other changes are noted in the other structures.

Two Years (Fig. 5). The only evident change is a small shadow which may be the beginning of ossification within the coracoid.

SUMMARY

During the first two years ossification is noted in one epiphysis for the upper end of the humerus. The other structures showing evidence of ossification are all of the prominences of the scapula, except the coracoid which only shows slight evidence of ossification toward the latter part of the second year.

Three Years (Fig. 6). The upper end of the shaft has changed its appearance, from the transverse line, to an angular appearance, sloping downward and outward and downward and inward from a plane passed through the outer third of the shaft of the humerus. The inner slope of this upper end of the shaft is covered in about two thirds of its upper aspect by the ossified upper epiphysis. There is a shadow in the outer portion of the epiphysis, which seems to make the epiphysis fit over the tongue and grooved effect of the shaft.

This shadow in the outer portion of the upper epiphysis may be a separate epiphysis for the greater tuberosity or it may be a downward projection of the upper epiphysis to form the greater tuberosity as a portion of the original epiphysis for the head.

The coracoid by this time has grown to a rather large size.

Four Years and Six Months (Fig. 7). The upper epiphysis covers more than two thirds of the upper end of the diaphysis. The tongue and groove effect is more evident now than at previous periods. If the ossifying portion of the upper epiphysis which forms the greater tuberosity is a separate epiphysis, there is certainly no definite line of demarcation between the two.

Seven Years (Fig. 8). The upward projection of the diaphysis is entirely covered by the ossified upper epiphysis. If originally there were separate epiphyses for the head and greater tuberosity the two have certainly united at this time.

Eight Years (Fig. 9). There is closer approximation between the shaft and the epiphysis. Ossification from the shaft seems to proceed up into the epiphysis. The coracoid process is larger than in previous years.

Nine Years and Ten Months (Fig. 10). The diaphysis seems to be separated from the epiphysis for the head, by a triangular or wedge-shaped shadow. The impression given is that this wedge is separate and distinct from the shaft and also from the head.

This is not the true state of affairs but the appearance is rather an optical illusion due to the position of the arm when the picture was taken.

The lower part of the head represents the epiphyseal line and what afterwards becomes the anatomic neck.

The wedge-shaped shadow represents the greater tuberosity.

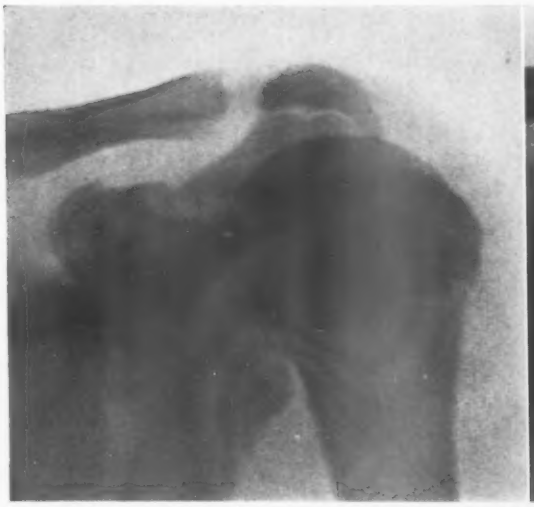


FIG. 13. Normal shoulder. Age: 14 years, 6 months.

FIG. 14. Normal shoulder. Age: 14 years, 8 months.

FIG. 15. Normal shoulder. Age: 15 years, 4 months.

FIG. 16. Normal shoulder. Age: 16 years, 10 months.

FIG. 17. Normal shoulder. Age: 17 years, 6 months.

FIG. 18. Normal shoulder. Age: 18 years, 7 months.

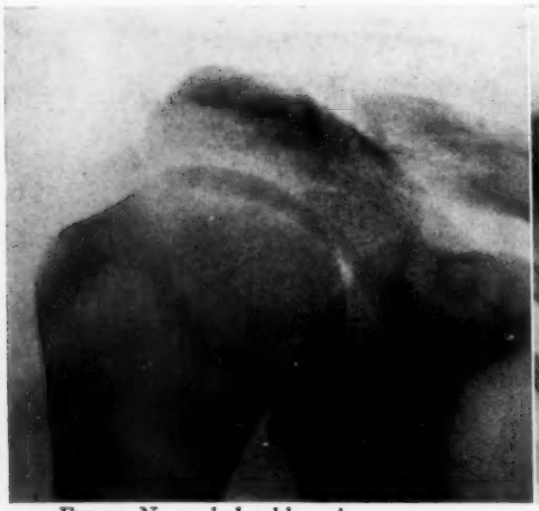


FIG. 19. Normal shoulder. Age: 20 years.

FIG. 20. Normal shoulder.

Eleven Years and Six Months (Fig. 11). There is closer approximation between the shaft and the epiphysis. At this time there is no evidence of union within the epiphysis of the acromion process.

Fourteen Years (Fig.12). There is closer approximation of epiphysis and diaphysis, but no evidence of ossification between the two. The coracoid process is well developed. There is still no evidence of ossification of the epiphysis for the acromion.

Fourteen Years and Six Months (Fig. 13). This is similar to the appearance at fourteen years, with the exception that there is a well developed acromion process. The epiphysis is separated by a definite line from the acromion proper.

Fourteen Years and Eight Months (Fig. 14). There is complete ossification of the upper epiphysis of the humerus, almost complete obliteration of the epiphyseal line, except the lower portion of the greater tuberosity which is still separated by a well defined line.

At this age, the acromion epiphysis seems completely ossified and united to the remainder of the acromion. This is an occasional finding.

Fifteen Years and Four Months (Fig. 15). The wedge-shaped appearance of the upper end of the shaft is here replaced by an almost flat top of the shaft, superimposed on which is the ossified upper epiphysis which is not united yet to the shaft. The acromion is not united to its epiphysis, although the epiphysis shows evidence of almost complete ossification.

Sixteen Years and Ten Months (Fig. 16). The greater tuberosity seems not to be united entirely with the diaphysis. Between the remaining portion of the epiphysis and diaphysis union seems complete.

The epiphyseal line between the acromion and the diaphysis of the scapula is still very marked.

Seventeen Years and Six Months (Fig. 17). Incomplete union of the epiphysis and diaphysis. The acromion process is not yet united to the shaft.

Eighteen Years and Seven Months (Fig. 18).Complete ossification of the epiphysis and almost complete union of the epiphysis and shaft. Scapula ossified throughout.

Twenty Years (Fig. 19). Complete ossification and union of the respective epiphyses and diaphyses.

CONCLUSIONS

Radiologic examination of the shoulder girdle during the first year shows only one epiphysis sufficiently ossified to leave a shadow, the epiphysis for the upper end of the humerus. This epiphysis is represented by a small elliptical shadow, which is rather widely separated from the upper end of the shaft. Our earliest observation was seven weeks.

During the first two years no other epiphysis makes its appearance, except for a

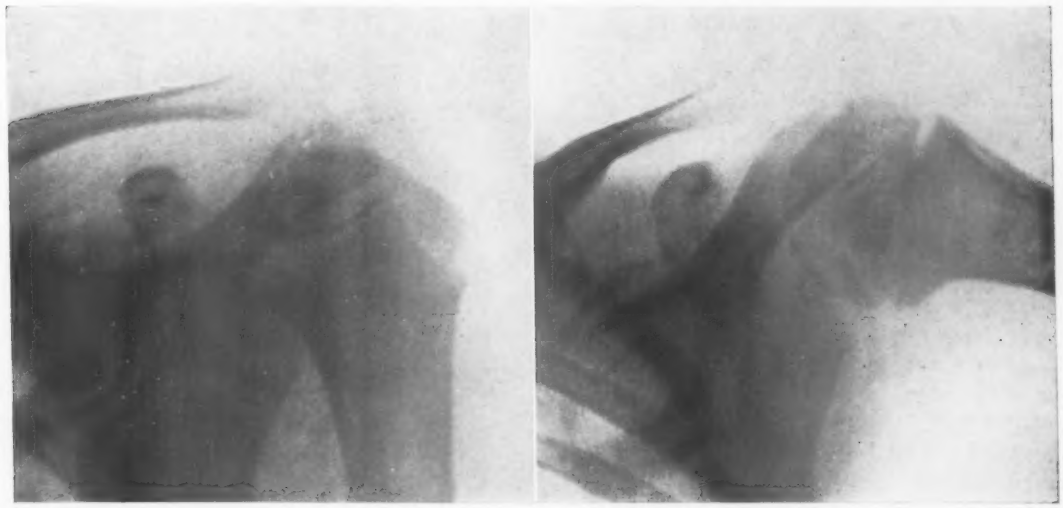


FIG. 21. FIG. 22.

Figures 20, 21 and 22 represent the altered radiologic appearance of the same shoulder, caused by a change in its position.

small shadow which may be interpreted as the early ossification within the coracoid process.

During the third year the head of the humerus increases rather rapidly in size. The upper end of the shaft takes on the appearance of a double inclined plane, higher near the middle and sloping downward to either side.

At this time there is a shadow on the outer and lower aspect of the epiphysis for the head, which may be ossification within a separate epiphysis for the greater tuberosity or it may be that the greater tuberosity is a downward growth from the original epiphysis for the head. In the pictures no clear line of demarcation can be made out between the shadows.

Beginning ossification within the coracoid is evident at three years.

In order to avoid errors of interpretation in roentgenograms of the shoulder one must take several views.

Ossification within the epiphysis of the acromion is rarely evident before the middle of the fourteenth year.

Complete ossification of the acromion epiphysis takes place about the middle of the eighteenth year.

Complete ossification within the upper epiphysis is evident about the nineteenth year.

There is no trace of the epiphyseal line at the twentieth year.

BIBLIOGRAPHY

1. BOWEN. *Interstate M. J.*, June, 1915, xxi, 607.
2. COHN. Normal Elbows. *Arch. Surg.*, May, 1921.
3. PRESTON, M. A. Fractures and Dislocations. St. Louis, 1915, p. 88.
4. CUNNINGHAM, D. J. Text-Book of Anatomy. New York, 1921.
5. EISENDRATH, D. N. Clinical Anatomy, 2nd ed., Philadelphia, 1907, p. 362.
6. WILLIAMS, F. A. The Roentgen Rays in Medicine and Surgery, New York, 1902.

SOME OBSERVATIONS ON THE TREATMENT OF HYPERTHYROIDISM WITH X-RAYS*

By GEORGE W. HOLMES, M.D.

Roentgenologist to the Massachusetts General Hospital and Instructor in Roentgenology, Harvard Medical School

BOSTON, MASSACHUSETTS

IN 1919, we reported in the *Journal of the American Medical Association* the results of our observations on 262 cases of hyperthyroidism treated with *x*-rays, and reviewed the literature up to that year. Since that time, we have had an opportunity to observe 107 additional cases.

In this paper, I shall not attempt a statistical study of the cases seen, but will present to you the observations we have made in studying this rather large group of cases, with a description of the methods employed and the results obtained.

The successful treatment of hyperthyroidism requires the best possible cooperation of the clinician, surgeon and roentgenologist. To accomplish this at the Massachusetts General Hospital, we have established a goiter commission consisting of an internist, surgeon and roentgenologist. This committee meets once a week, and all patients are seen by the members in consultation. If the patient is a new one, an attempt is made to make a definite diagnosis of the type of disease present, and the form of treatment agreed upon. Old cases are reexamined before changing the form of treatment, also for observation and discharge. Metabolism tests are made before, after and during treatment. Sources of infection, such as diseased teeth, tonsils, etc. are looked for, and, if found, proper treatment is instituted. The condition of the heart is observed, and, in women, the pelvic organs are examined. The presence or absence of an enlarged thymus gland is determined, when possible. The patient's occupation, home life and the distance of residence from the clinic are considered.

A photograph of the patient is made and the pulse rate, weight, temperature and metabolism rate are charted.

In determining the form of treatment to be instituted in each individual case, we consider:

1. The type of disease present.
2. The environment and distance of residence.

We have found the following grouping fairly satisfactory for this purpose:

Colloidal, cystic and simple goiters.
Malignant goiters.
Toxic adenomata.
Non-toxic adenomata.
Exophthalmic goiters.

Colloidal, cystic and simple goiters should never be subjected to roentgenization. If they cause pressure symptoms, or, if for other reasons it is advisable to remove them, surgery is advised.

In malignant goiter, we advise immediate operation followed by postoperative raying. If, for any reason, surgery is contraindicated, roentgenization alone may bring about a temporary cure. A patient of this type came under my observation in 1916, three years after she had been operated upon. At the time of this observation, she had extensive recurrence with metastases in the lungs.

Under roentgenization, these signs disappeared, and she was free from symptoms until death of intercurrent disease in 1921.

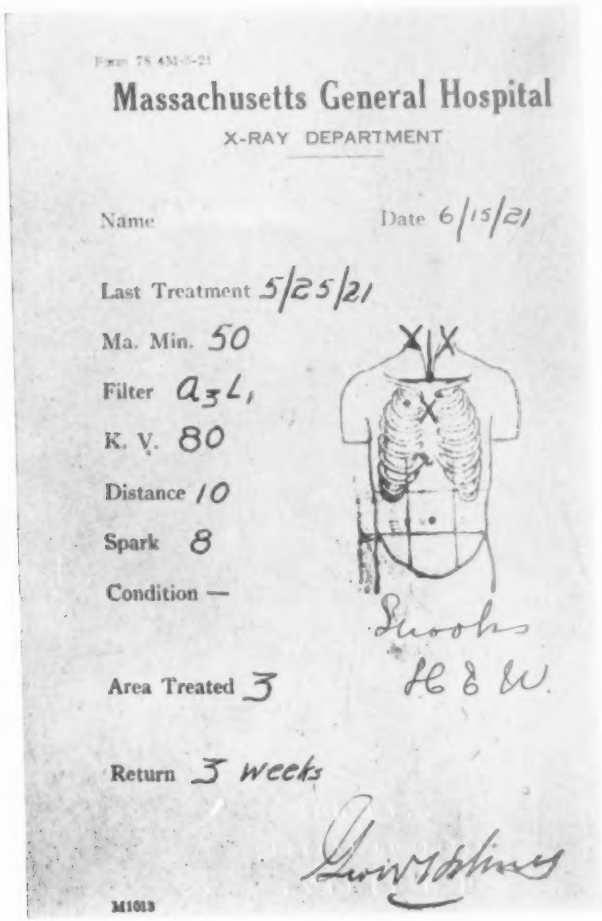
Toxic adenomata respond readily to *x*-ray treatment, but surgery is quicker, and, as the surgical risk is slight, most of these cases are referred for operation.

We have never treated a non-toxic adenoma, though I see no reason why localized nodules could not be reduced by exposure to radiation. As a rule, these cases are kept under observation or treated surgically.

Exophthalmic goiters are usually started on rest and radiation. It has been our experience that the surgical risk is considerably greater in this class of cases, and that they respond very well to roentgenotherapy.

The importance of rest increases with the toxicity of the case, and those having a very high metabolism are usually given some rest before instituting *x*-ray treatment. Even in

*Read at the Twenty-Second Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Washington, D.C., Sept. 27-30, 1921.


Form 78 4M-6-21

Massachusetts General Hospital

X-RAY DEPARTMENT

Name Date 6/15/21

Last Treatment 5/25/21

Ma. Min. 50

Filter Al 3

K. V. 80

Distance 10

Spark 8

Condition —

Area Treated 3

Return 3 weeks

M1013

FIG. 1. A prescription for treatment.

clinics where surgery is used exclusively, this type of case would be given a rather long period of rest, and we believe rest, combined with *x*-ray treatment, gets the patient in much better condition for operation and reduces the operative risk by destruction of the thymus, and, if not too much prolonged, does not make the operation more difficult. As a matter of fact, a large percentage of cases so treated never come to operation.

The following cases are illustrative of the types treated and the results obtained:

CASE I. Exopthalmic goiter of long duration in a woman, aged forty-one. Toxic symptoms were marked for four years. There was a symmetrical marked enlargement of the thyroid with exophthalmos and emaciation. Systolic bruit was present. The accompanying chart shows the course of the disease under treatment.

Treatment was started in March, 1918. At that time, the patient's metabolism was 85 per cent above normal, pulse rate 120, and weight 52 kgm. Three weeks later, a second treatment was given, at which time there was no marked change in her condition. In nine months, she had received six treatments, during which time there was a steady rise in weight and drop in the pulse rate and metabolism. She was given two more treatments in April and May, 1919, making ten treatments in all, covering a period of one year. The metabolism rate was slightly elevated until the latter part of 1919 when it reached normal, and it has remained so since. Her last metabolism observation was in December, 1920. Since that time, she has been under general observation and apparently is entirely well.

This case seems to represent a cure by *x*-ray treatment of a long-standing severe type of exophthalmic goiter. The period of time dating from the initial treatment, before metabolism reached normal (practically two years), would probably have been shortened considerably had surgery been used. But on the other hand, the patient was an extremely poor surgical risk, and her present condition is in every way satisfactory. It is also probable that the periods between treatments were longer than necessary, and that somewhat heavier dosage might have been used.

CASE II. Exophthalmic goiter, a rather mild early case in a man aged forty-two. Toxic symptoms present for six months.

At the time of his first treatment in April, 1920, he had lost 20 lbs. in weight during the preceding six months. There was sweating of the hands, palpitation, dypsnea, slight enlargement of the thyroid and exophthalmos. His basal metabolism was 40 per cent above normal, his pulse rate 95 and his weight 40 kgm.

He was given one *x*-ray treatment in April, another in May, and in June a second metabolism test was made, at which time there was a drop to 10 per cent above normal, and a rise in weight to 46 kgm. Three more *x*-ray treatments were given, the last in August, 1920, four months after beginning treatment. His last metabolism observation was made in June 1921. It was practically normal. His pulse rate at that time

FIG. 2. CASE I before treatment.

FIG. 3. CASE I after treatment.

was 72 and his weight had reached 52 kgm. and he was practically free from symptoms. He is a tailor by trade, and at no time did he stop work.

This case illustrates the prompt response to treatment of a mild early case, a cure being brought about in the short period of four months without interfering with the patient's mode of living or occupation. He has been under observation now for over a year and has remained well.

CASE III. Toxic goiter of moderate severity, of rather long duration (five years), in a woman, aged forty. No eye signs and no

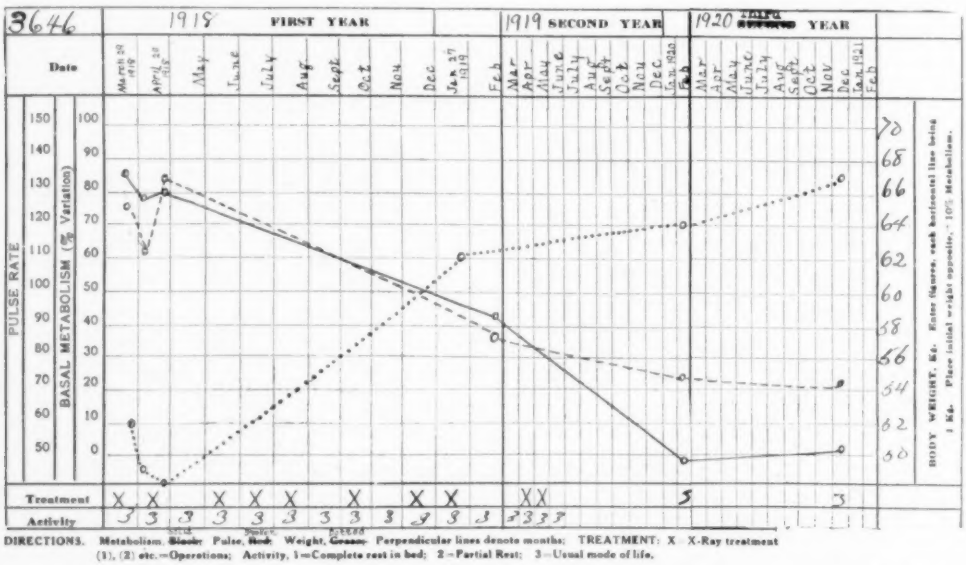


FIG. 4. CASE I. Chart showing the results of *x*-ray treatment in a case of exophthalmic goiter of long standing.

FIG. 5. CASE II before treatment.

FIG. 6. CASE II after treatment.

evidence of localized adenomata, and definitely worse during the year preceding treatment. The goiter committee advised rest and *x*-ray treatment followed by surgery if necessary.

When the patient was first seen on September 24th, 1920, her metabolism was 49 per cent, her pulse rate 100, and her weight 45 kgm. She was given an *x*-ray treatment and complete rest in bed. At the end of a month, a second treatment was given. At this time, there was a slight drop in the

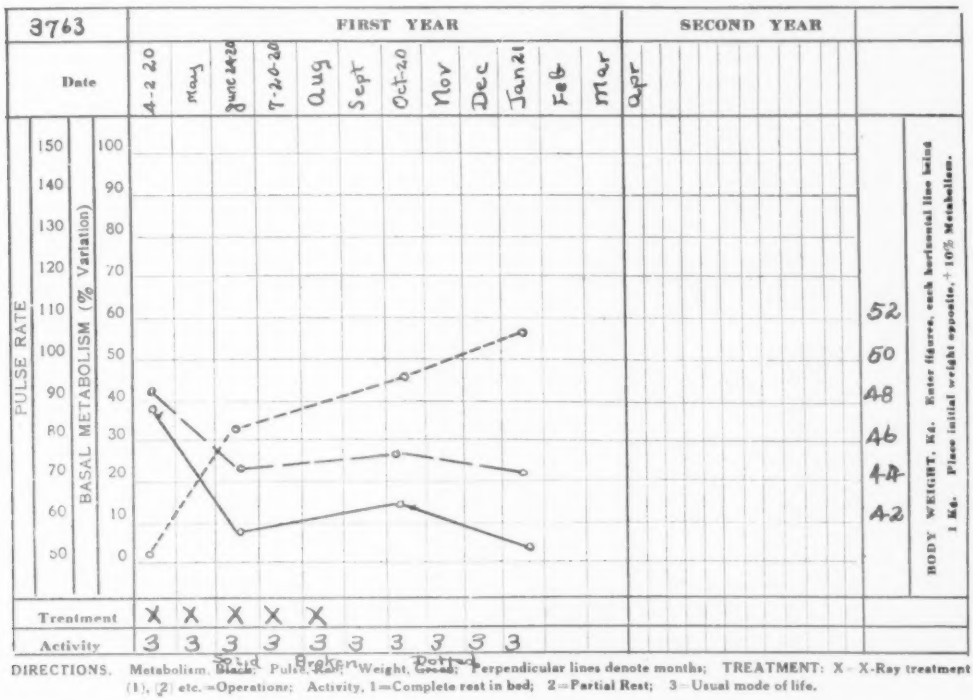


FIG. 7. CASE II. Chart showing results in a rather mild early case of exophthalmic goiter.

FIG. 8. CASE III before treatment

FIG. 9. CASE III after treatment.

pulse rate and metabolism, but no gain in weight. Between October, 1920, and April, 1921, she received nine treatments, making eleven treatments in all. At this time, her weight had reached 57 kgm., her pulse rate, 90, and her metabolism 10 per cent above normal. The last observation was made in August, 1921, at which time her weight had

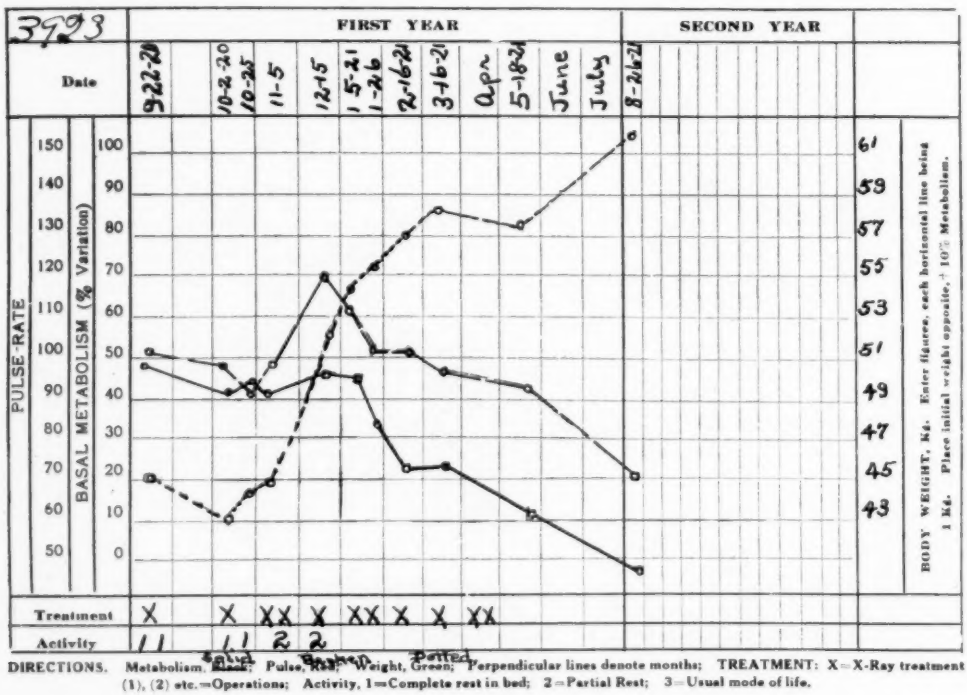


FIG. 10. CASE III. Chart showing the results in a case of toxic adenoma.

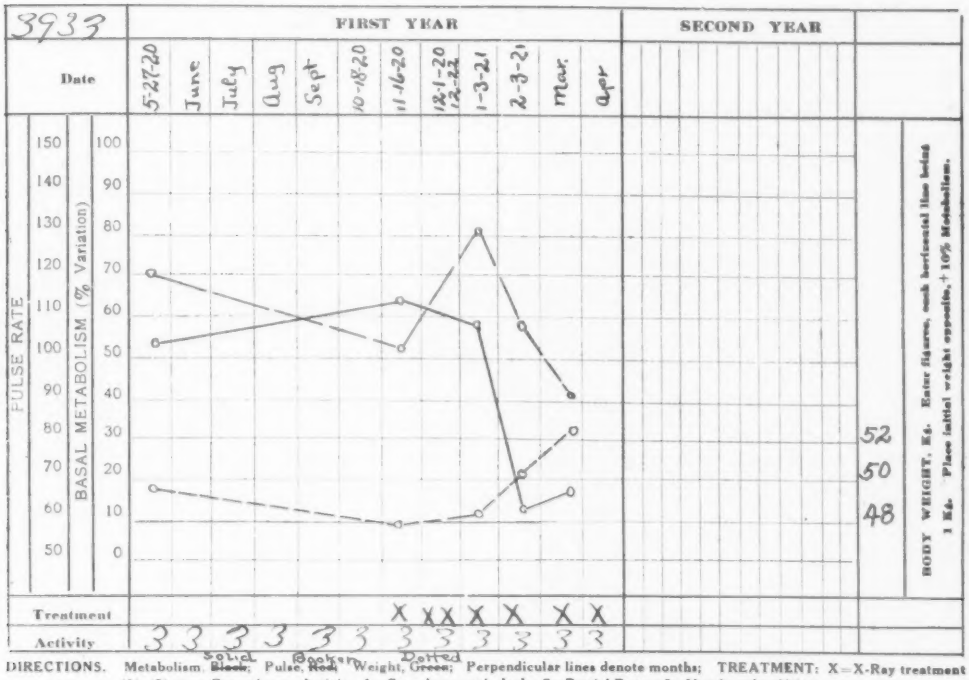


FIG. 11. Chart of the results in Case IV.

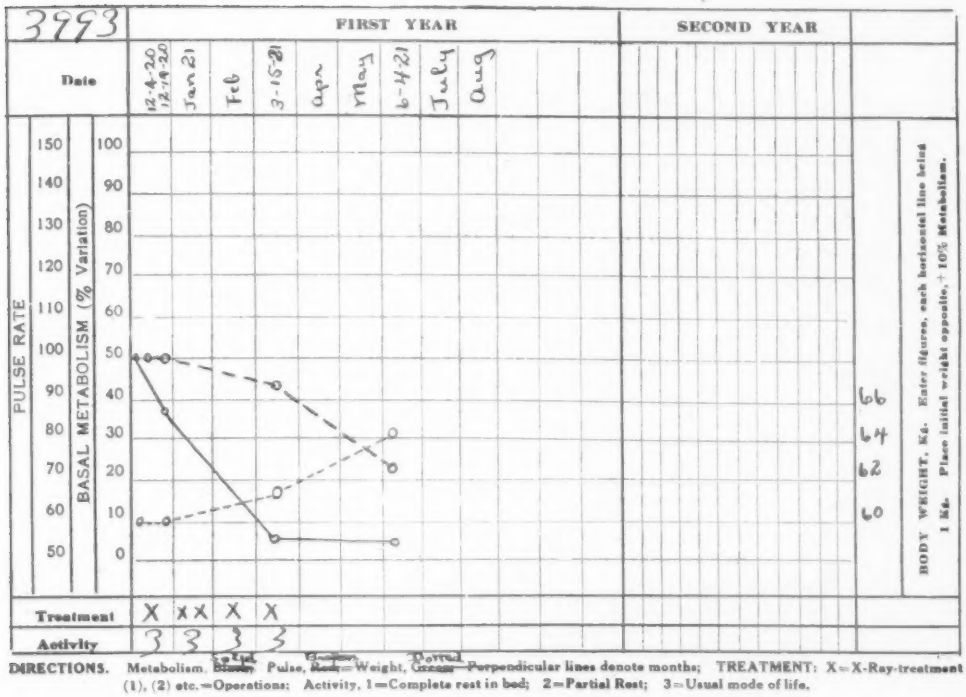


FIG. 12. Chart showing the results in Case V.

reached 61 kgm., the pulse rate, 70, and her metabolism slightly below normal.

This case was probably a rather long-standing toxic adenomata. Her treatments were given at a 16-inch target skin distance, using one field of entry covering the thymus and thyroid region, supplemented by complete rest for the first two months and partial rest for three more.

At the present time, this patient is entirely free from the toxic symptoms. The very rapid gain in weight, with low metabolism, may mean the beginning of hyperthyroidism. I believe that the treatment should have been stopped sooner.

Case IV. An adenoma of long duration in a woman, aged forty-one.

When the patient was first seen in April, 1920, toxic symptoms had been present for only a few weeks, but there was a history of enlargement of the thyroid for twenty-four years. She had had some medical treatment. She was suffering from nervousness, irritability, occasional attacks of diarrhea, palpitation and loss of weight. Her metabolism was +54 per cent, her pulse rate 120, and weight 49 kgm.

X-ray treatment was advised. The patient did not return for treatment, however, until the following November, seven months after the first observation. She had had no treatment during that time. There had been a slight drop in the pulse rate and some loss of weight. The metabolism was + 64 per cent. In general, her condition was about the same. Between November and January, she received four *x*-ray treatments. A metabolism test made at that time showed 59 per cent above normal. Her pulse rate and weight were practically unchanged. Three more treatments were given, and a metabolism observation in March showed a very definite drop to 12 per cent above normal. Her weight had reached 52 kgm. and her pulse rate was 90. The last observation on this patient was made on June 28, 1921. She had been working unusually hard during the spring. She complained of occasional attacks of palpitation, but was free otherwise from symptoms.

This case is of interest because of the rather long period in which she was under observation before starting treatment, and the absence of any improvement until treatment was given,—seven months' observation without treatment and no change in condition; four months under treatment and practically complete disappearance of symptoms.

Case V. Exophthalmic goiter (postoperative) in a woman, aged forty-four. The toxic symptoms were of eight years' duration. In 1913, a partial thyroidectomy was done.

When first seen in December, 1920, patient complained of nervousness, irritability, dyspnea, palpitation and loss of weight. The heart was considerably enlarged and edema of the feet was present. There was well-marked fullness over both lobes of the thyroid, and the scar of the old operation was present. The tumor was vascular and fairly soft. Her metabolism was +50 per cent, pulse rate 100, and weight 60 kgm. She was given five *x*-ray treatments between December and March, at which time a second metabolism test was made and the rate found to be normal. There had been a slight gain in weight and a slight drop in pulse rate. In June, 1921, her weight had reached 64 kgm., her pulse rate had dropped to 72 and her metabolism remained normal. There was no marked decrease in the size of the goiter, but she was free practically from symptoms of hyperthyroidism, and her cardiac condition was much improved.

This case represents an incomplete surgical cure, of long duration, with a badly damaged heart. Under *x*-ray treatment, the cure was completed in a period of three months.

Case VI. A rather severe acute exophthalmic goiter in a woman, aged thirty-two.

When patient was first seen in April, 1920, she was suffering from nervousness, irritability, sweating, dyspnea, palpitation, increased appetite and loss of weight. She was also emaciated. There was a moderate symmetrical enlargement of the thyroid. Exophthalmos was present. Her metabolism was +72 per cent, her pulse rate 120, and her weight 36 kgm.

Rest and *x*-ray treatment were advised. The patient was unable to carry out this program, and only partial rest was obtained. After receiving four treatments, her metabolism had dropped to +35, the pulse rate to 95 and the weight had increased 2 kgm. Treatments were continued, four more be-

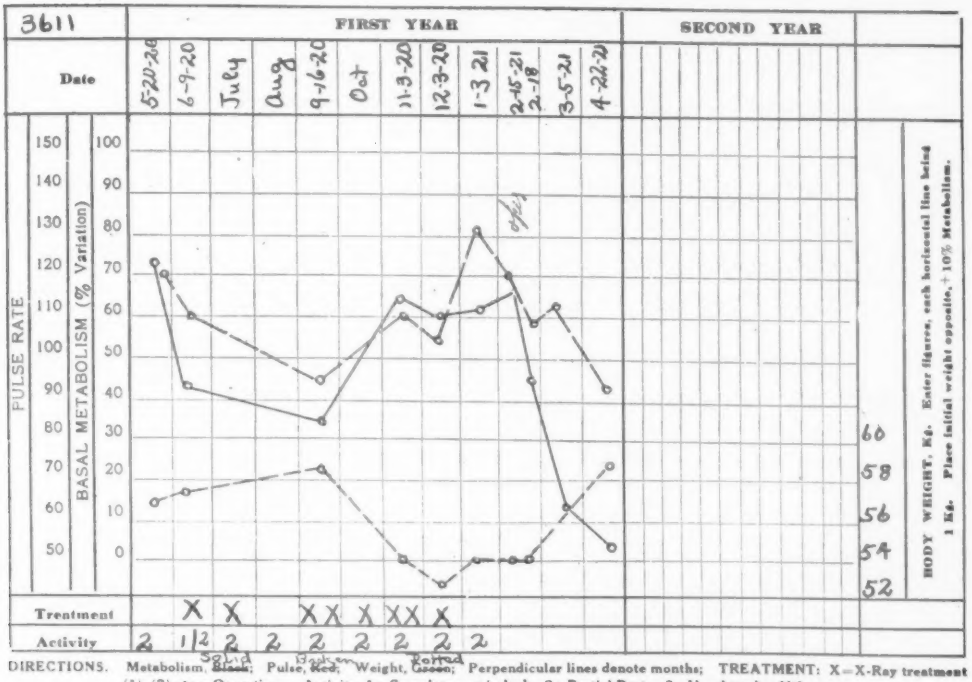


FIG. 13. Chart showing the result in Case VI.

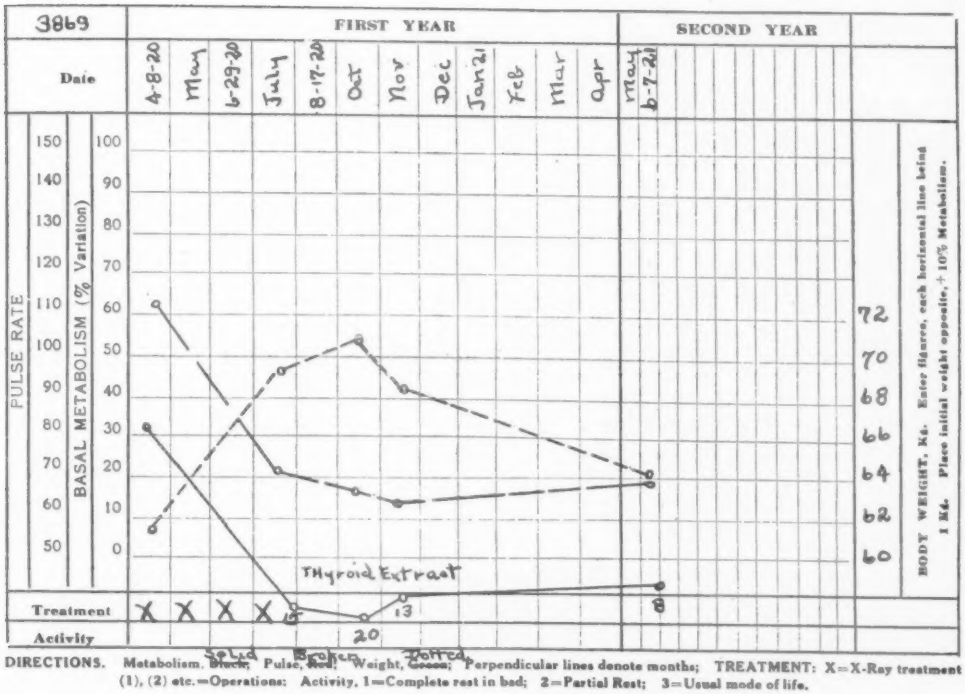


FIG. 14. Chart showing the course of the disease in Case VII.

ing given. In December, after a period of seven months, she had received eight treatments. Her metabolism had returned to 60 above normal, her pulse rate was over 100 and her weight had dropped to 54 kgm. As she was not doing well, she was seen in consultation, and surgery was advised. Ligation, followed by a hemithyroidectomy, was done. She was seen last on April 4, 1921, at which time her metabolism had dropped to normal. Her pulse rate was 90 and her weight 58 kgm.

This case is one of a small group which has failed to respond to *x*-ray treatment in a reasonable length of time and in which we have resorted to surgery. A comparison of this case with those which respond well does not reveal any striking difference in the symptoms or history of the disease. It may be that the failure is due to error in technique.

Case VII. An early typical case of exophthalmic goiter of a rather mild grade, in a woman, aged thirty-six.

When she was first seen in April, 1920; she had had toxic symptoms for five months, and a noticeable goiter for six months. She complained of nervousness, irritability, palpitation, sweating and loss of weight. The thyroid was soft, symmetrical and slightly enlarged. A faint bruit was present, and also considerable exophthalmos. Her metabolism was 30 per cent above normal, the pulse rate, 110, and her weight, 65 kgm.

X-ray treatment was advised. There was no change in the patient's mode of living.. Treatment was given at an 8-inch distance, using three portals of entry. By this time her metabolism had dropped to 10 per cent below normal, her pulse rate was 70, and her weight had reached 69 kgm. She showed definite signs of hyperthyroidism. *X*-ray treatment was stopped, and she was placed on thyroid extract. In November, her metabolism was still slightly below normal. The thyroid extract was continued until March, 1921. From an observation made the following June, three months after discontinuing the thyroid tablets, her weight was 64 kgm. pulse rate, 70, and metabolism slightly below normal. At this time, she showed practically no signs of myxedoma or of hyperthyroidism. This patient received only four treatments given in the routine manner, in a period of less than four months, and changed from a state of mild hyperthyroidism to mild myxedema. This condition was apparently temporary, however, as she is now getting along very well without thyroid extract.

This case is especially interesting, as it seems to show that the *x*-ray may bring about a temporary inhibition of thyroid function.

Case VIII. A moderately severe case of hyperthyroidism, apparently adenomatous, in a woman, aged thirty-eight. The goiter and toxic symptoms were of one year's duration.

When the patient was first seen in October, 1919, she complained of nervousness, irritability, dyspnea and loss of weight. The goiter was small and firm, with a loud bruit. There was no exopthalmos. Her metabolism was 50 per cent above normal, her pulse rate 115, and her weight 39 kilograms.

She was started on *x*-ray treatment and no change was made in her manner of living. After three treatments were given, there was a slight gain in weight and a drop in the pulse rate. No definite change in the metabolism rate was noted, however, but, after six treatments, covering a period of four months, her metabolism dropped to 8 per cent above normal, her pulse rate to 90, and her weight had reached 49 kgm. One more treatment was given and she was requested to return for observation in six months. This observation was made in September, 1920, at which time her weight, pulse rate and metabolism were practically normal. She was seen again in Febraury, 1921, and all the findings were approximately the same, but in July, 1921, when she reappeared for examination, her metabolism had dropped well below normal, her pulse rate was only 50 and her weight unchanged. Her skin was dry and she showed definite signs of myxedema.

The interesting feature in this case is the development of myxedema nearly two years after the last *x*-ray treatment, and after the patient had been well for a period of over one year. It is possible that the results in this case are due to the development and contraction of fibrous tissue causing interference with the function of gland, or she may be one of those cases of hyperthyroidism

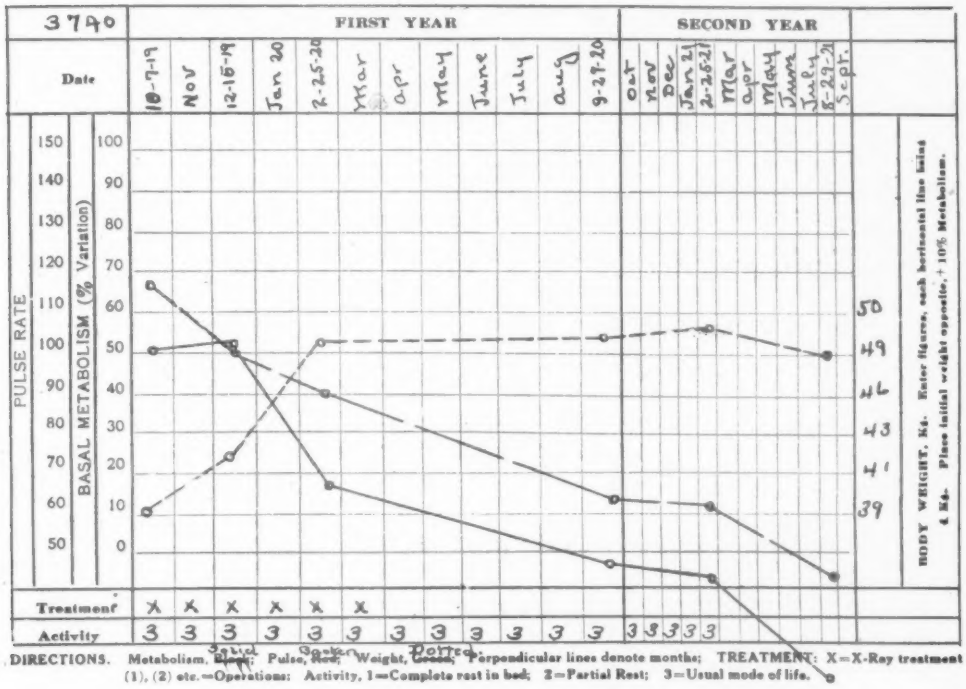


FIG. 15. Chart showing the course of the disease in Case VIII.

which develop late myxedema regardless of treatment.

TECHNIQUE

In the light of our present knowledge, it is fair to assume that the following physiological and histological processes take place when the thyroid gland is subject to radiation.

The function of the cells composing the glandular structures is inhibited. As the dose is increased these cells atrophy and disappear, to be replaced by connective tissue, and, after a lapse of considerable time, where heavy raying has been given, it is possible that the contraction of this new fibrous tissue may interfere with the blood supply to such an extent as further to inhibit glandular function. The dose, therefore, should be adapted to the type of case under treatment, and must of necessity, be within the limits of skin tolerance. In mild cases, with little or no thyroid enlargement, a dose sufficient to inhibit glandular function repeated at intervals may be all that is required to bring about a cure. In more severe cases, with larger glands, heavier radiation (given at more frequent intervals so that there will be not only inhibition but cell atrophy) is probably necessary. In these cases, however, the dose should not be too large, nor the treatment too prolonged, otherwise the destruction of the gland, or the late results of connective tissue contraction, may be so great as to bring about a complete loss of function, with resulting myxedema. In very severe cases, it may be justifiable to give as large a dose as the skin will tolerate, even producing a slight erythema, and not guarding particularly against the complete destruction of the gland.

As already stated, the dosage will vary with the type of case. We have employed a 4 mm. aluminum filter with 8 inch parallel spark gap between points. An 8 inch target skin distance was used in our early cases. Lately we have used a 10 inch, and, in some cases, a 16 inch distance. In this way, the amount of radiation reaching the gland in proportion to that received by the skin is increased. In most of the cases, three exposure areas have been used, one on each side of the neck, and one over the thymus region. In some cases, where a 16 inch distance was used, we have given one single exposure in front over the midline including the entire thyroid and upper thymus region.

In a small group of cases, five areas of ex-

posure were used, one over each side of the neck, one over the thymus region and two over the back of the neck. No definite advantage was noted in this method of exposure. The time interval between treatments has been usually three weeks. In some we have shortened it to two weeks. I believe that it is a safer procedure when one wants to get the maximum effect, short of an erythema, to diminish the time, rather than to increase the dosage.

Basal metabolism tests are done frequently during the early part of the treatment, and, as improvement takes place, less frequent observations are made. The findings are recorded on a chart along with a record of the pulse rate and weight. This chart occupies the same relation to the treatment of hyperthyroidism as the temperature chart in the treatment of fevers. When the basal metabolism reaches normal, treatment is stopped, and sooner, if the drop has been rapid.

RESULTS TO BE EXPECTED IN THE TREATMENT

In cases which respond favorably to treatment, an improvement in the nervous symptoms is usually noted at the end of the first three weeks' interval. At the end of six weeks there should be a definite drop in the pulse rate and in the metabolism, but in many cases the response is more gradual. The metabolism and the pulse rate usually return to normal after six or seven treatments have been given, and in a period of from four to six months. There is usually a gradual increase in weight, the goiter disappears, and the exophthalmos, when present, is relieved and may disappear entirely. Frequently a severe toxic case is able to return to work after the third treatment and from that time on, his treatment need not interfere greatly with his routine life. In cases which are more stubborn, rest should be insisted upon, or surgery resorted to after the fourth or fifth treatment. It is not desirable to prolong the treatment in cases which are not responding well, as the operation will be made more difficult. Four or five treatments given within a period of six months have not in our experience done this. On the other hand, cases which have received a larger number of treatments over periods of from one to two years have been distinctly more difficult at operation. There is, of course, a definite possibility of damage to the skin, such as atrophy and telangiectasia. These results apparently can be avoided by keeping well below the erythema dose. When they happen, they are more disfiguring than the usual surgical scar. The longer time required to bring about a disappearance of the toxic symptoms by *x*-rays may be used as an argument in favor of surgery. This increased interval may increase the damage already done to the heart. On the other hand, one may argue that the amount of damage caused by the stress of operation would be more than that likely to take place in an interval of three or four months during which there was a steady drop in the amount of toxemias present. Myxodema may be brought about by too heavy or too prolonged radiation. It is also possible that this condition may develop several years after radiation as the result of contracting connective tissue, Any observation along this line, must of course, be indefinite, because of the fact that cases of hyperthyroidism frequently become myxedematous under all forms of treatment, and even when no treatment is given.

INTENSIVE X-RAY THERAPY AS SEEN PRACTICED IN THE CLINICS IN EUROPE*

By SAMUEL STERN, M.D.

Radiotherapist to Mount Sinai Hospital.

NEW YORK CITY

THE subject of intensive roentgenotherapy as practiced in Germany and in other foreign countries at present, has been the source of a great deal of interest to the American roentgenologist. Having returned but recently from a visit to the various clinics in Germany, I thought a résumé of my impressions might be of value in helping to clear the atmosphere of some of the confusion in which this subject seems to be enveloped at present. I have found that there seems to be a unanimity of opinion on but two of the essentials in carrying out intensive *x*-ray therapy:

1. The necessity of having apparatus that is able to deliver at least 200,000 volts.

2. The essential employment of heavy filters.

On all other, even the most important and vital questions of technique, there is the greatest divergence of opinion. Each man firmly believes that his method is superior to the others, and can usually give an apparently logical reason for this belief. I think this clearly shows that the really essential factors are the deliverance of heavily filtered, highly penetrating rays to the parts treated, and that all the other details on which we lay so much stress are of secondary consideration. The technique briefly described, as I have seen it used at the various clinics, is as follows.

FRANKFORT FRAUEN CLINIC

(Profs. Opitz and Walter Friedrich)

Distance	*Size of fields*	*Time*	*Filter*	*S. G.*	*ma.*
50 cm.	25 x 25	6 to 7 hrs.	1 c. mm.	38 cm.	2½

Mammary carcinoma. 1 large field.

Uterine Carcinoma. 2 fields, front and back.

The treatment is not repeated, surely not within six months of its administration.

Myoma

Distance	*Size of fields*	*Time*	*Filter*	*S. G.*	*ma.*
30 cm. with compression	16 x 16	4 to 5 hrs.	1 c. mm.	38	2

In large myomas, the distance used is 50 cm. and the rest of the formula is similar to that of carcinoma, except the time is shorter. The method of measuring is with a specially devised iontoquantimeter perfected by Professor Friedrich. This instrument enables him to measure the exact dosage administered, irrespective of filter, penetration, distance or any other detail.

One hundred and seventy electrostatic skin units make an erythema dose. This can be kept track of without stopping the apparatus even for an instant, and when this number is reached, he feels certain that the patient has received the exact dosage intended to be given. He has been using this apparatus for the past two years, and claims that it is absolutely reliable and can always be depended upon. He considers that the question of *x*-ray measurement is solved. I found him to be one of the most brilliant physicists I have met, and I feel that we cannot lay too much stress upon any statement that he may make. The apparatus, very superficially described, consists of a small (1 c. cm. capacity) ionization chamber made of aluminum, which is connected with a rubber tubing to a large ionization chamber fitted with a gold leaf electroscope. This is charged, and as the rays strike the small ionization chamber, it is gradually discharged and the time carefully noted. Each apparatus is tested to determine how many electrostatic units each discharge represents. These are carefully added up, and, when the required total is

*Read at the Twenty-Second Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Washington, D.C., Sept. 27-30, 1921.

reached, treatment is stopped. There are some inaccuracies due to the self discharge of the electroscopes, which must be taken care of. This is done by charging the electroscope to 6 and then waiting to see how much it will discharge of its own accord, during the time that it took for one complete discharge with the ray in operation. We now determine how long it takes to discharge this number of units with the ray, and then multiply this time with the number of times the electroscope has been discharged during the treatment. This amount of ray is added to complete the dosage. All this sounds rather complicated, but is really very simple. The small ionization chamber can be left on the skin during this treatment to measure skin dosage, or it can be inserted into the rectum or vagina, to measure depth dosage. The carcinoma dose as measured in the vagina is 152 electrostatic units. The myoma dose is 100 to 120 skin units to each field, or 80 units measured in the vagina. In making measurements in the vagina, a permanent horse hoof catheter is kept in the bladder to keep this organ empty.

FREIBURG DEPARTMENT OF INTERNAL MEDICINE

(Profs. De la Camp and Kupferle)

Malignancy

Distance	*Size of fields*	*Time*	*Filter*	*S. G.*	*ma.*
30 cm.	10 x 10	1 hr.	1½ c. mm.	180 to 200 kv.	2

This dose is administered every eight days until the patient has had four treatments; then it is repeated in six to eight weeks.

Tuberculosis of the Lungs. Cases must be selected very carefully. No tertiary cases are treated. The affected area is divided into three fields: anterior, lateral and posterior. Each field is treated as follows:

Distance	*Size of fields*	*Time*	*Filter*	*S. G.*	*ma.*
30 cm.	Small	8 to 10 m.	1 c. mm.	170 kv.	2

Treatments are given every eight days until each field receives three treatments, then they are discontinued for many months.

The treatment of tuberculous adenitis is the same as above, except that the time is fifteen minutes. It is repeated every eight days or two weeks.

Basedow's Disease. The thyroid and thymus region is divided into four fields, two supra- and two infraclavicular. One field is treated twice a week, so that each field receives a treatment every two weeks. The technique used is the same as that in tuberculosis, except that the time is from twenty-five to thirty minutes. The series is repeated three or four times, followed by a long wait.

FREIBURG SURGICAL CLINIC

(Prof. Lexar and Dr. Kohler)

Malignancy

Distance	*Size of fields*	*Time*	*Filter*	*S. G.*	*ma.*
50 cm.	Large	3 hrs.	0.75 zinc	200	2

The dose is repeated every four weeks until the patient has had four or five treatments.

Fractures. For the past year and a half they have been treating fresh fractures, with so-called irritating doses, with most satisfactory results. They have succeeded in reducing the healing time to about one half. Usually only one treatment is given, as shortly as possible after the fracture has been set. The dose given is about 1 / 10 of an erythema dose.

Distance	*Time*	*Filter*	*S. G.*	*ma.*
30 cm.	10 m.	½ c. mm.	180 kv.	2

In small bones only one field is treated, larger bones are treated anteriorly and posteriorly, but with reduced time.

Tuberculous bones and joints are treated once in three weeks, with even smaller irritating doses—1 / 20 to 1 / 30 of an erythema dose, that is, about one to four minutes, using the above formula.

To take advantage of the use of scattered rays, in the treatment of small bones, the field is enlarged by wrapping them in wet towels.

Late Rachitis. They found marked benefit in the treatment of these cases by exposing both temporal regions. Two treatments are given at four to six week intervals, using

about 1 / 3 of an erythema dose, with 0.5 zinc filter.

Prophylactic Treatments. These are given very much like the treatments for existing malignancy—every four weeks until five treatments are given in succession, then discontinued for six months, after which period three more treatments are given.

To avoid constitutional disturbances, during and following the treatments, they are using Uzara tablets with very satisfactory results. Two tablets are given about half an hour before the treatments. This dose may be repeated at any time as the drug is quite harmless.

FRANKFORT FRAUEN CLINIC
(Prof. Seitz.)

Mammary Carcinoma. The affected side is divided into three fields: a large field at a distance of 80 to 90 cm., taking in the entire breast region; a small field at 30 cm. distance over the supraclavicular space, and another small field at 30 cm. distance over the axilla. A full erythema dose is given to each field, using a 0.5 zinc filter and a 40 cm. spark gap. This is repeated in six weeks and again eight weeks later, if necessary.

Uterine carcinoma. These are treated in three series: Series I. Three fields in front and three fields in back at 23 cm. distance with compression, and one field over the vulva without the use of a speculum. Series II is given six weeks later over the affected uterine region, three fields in front and three fields in back. Series III is given eight weeks later over the parametrium. They also use 100 mgm. of radium with a 0.5 Cu filter, left in place from eighteen to twenty-four hours.

Myomas. These are treated through four fields: anterior, right and left at 23 cm. distance with compression, and the same posteriorly. They use 0.5 zinc filter, 40 cm. spark gap, and 2.2 ma. Under these conditions an erythema dose is given in about thirty-eight minutes, depending on the tube used. In large myomas, a fifth field is taken from above anteriorly.

They find that measured at 10 cm. depth, the ovarian dose is 30 to 40 per cent; the sarcoma dose is 60 to 70 per cent; and the carcinoma dose is 110 to 120 per cent.

In Frankfort I also visited the institute in charge of Prof. Friederich Dessauer. Here they have been doing some extremely valuable work in connection with the physics of *x*-ray therapy. Some of his work is of great value in determining the amount of dosage necessary in deep *x*-ray applications. After two years of experimenting, Prof. Dessauer has completed a set of charts, showing ray absorption at different depths, applied with filters of various thickness, at different distances, with the tube charged with varying kilovoltage. By taking measurements of the distance at which the affected parts are situated, and transferring these measurements to these charts, one can readily work out the necessary dosage that must be applied to each area to give the required depth dose. These charts show conclusively what an important role the scattered rays play in *x*-ray application. I do not think we ever realized how much ray the protected parts received, a great deal more than we ever suspected.

At the clinic of Prof. Wintz at Erlangen, for carcinoma of the uterus they use four fields from the front, 6 x 8, and three fields from the back, distance 23 cm. with compression, filter 0.5 Cu with the Suderöhre and 0.5 Cu + 4 mm. aluminum with the Cooliidge tube, spark gap 40 cm. and 2 ma. Exposure varies from thirty-eight to forty-five minutes. Six weeks later they treat three fields in front and three fields in back over the affected parametrium. Eight weeks later the same treatment is given over the other parametrium. They reckon on getting about 18 per cent at a depth of 10 cm. Instead of radium locally, they use a 0.5 solution of Cu selenium applied with the galvanic current in the form of cataphoresis. When patients receive a full erythema dose they always have a slight erythema the day following the treatment. Three or four days later the small hair papillae become raised and more reddened, a condition they call erythema papillaries. This they claim is constant. Five or six weeks later this is followed by an even pigmentation.

About the third or fourth week after the treatment the patient is usually given intravenously 1 c. cm. of serum and 20 c. cm. of normal saline solution.

Myoma. Small myomas are treated through two fields in front and two fields in

back at 23 cm. with compression. Large myomas receive four fields in front, two lower, 8 x 8 at 23 cm. and two upper 10 x 15, at 30 cm. distance, the same posteriorly.

Sarcoma of the Uterus. In their opinion, no sarcoma of any kind should ever be operated on. The results are good, providing there has been no surgical interference. They put the sarcoma dose at 80 per cent. The technique is the same as that for carcinoma.

Rectal carcinomas are divided into three classes:

1. Those that are situated 8 to 10 cm. distance up the rectum. They are the most favorable and are treated the same as carcinoma of the uterus.

2. Those that are situated 3 to 8 cm. up the rectum. The results are not so good, as it is very difficult to get the required percentage of depth dose to the lesion. They are treated through four fields.

3. Those situated at the anus. Prognosis in these cases is very bad. They are treated through one large field at a distance of one meter, two ingunial fields, and two additional fields from above, directing the ray downwards.

Carcinoma of the Vulva. This is treated at 1 meter distance to the lesion and two inguinal fields at 30 cm.

Carcinoma of the Bladder. The bladder is filled with normal saline solution and small fields, from right and left at 23 cm. with compression, are used. Then the bladder is emptied and one large field in the center at 70 cm. is exposed. This is repeated after six weeks and again eight weeks later.

I am not going into any details about the treatment of non-malignant conditions at this clinic. The technique is very similar, except that not more than ⅔ of an erythema dose is given.

At the Cancer Research Institute at Berlin, Prof. Blumenthal and Dr. Halberstadt, to supplement the effect of *x*-rays, inject intravenously an iodine preparation known as Alival. In treating *mammary carcinoma* they make it a rule to accept no cachetic patients, nor those with pleural or thoracic involvement. They take three fields, if possible, 8 x 10, otherwise one large field from the front, three fields for the axilla, and the supraclavicular space front and back. They use a distance of 30 cm., 0.5 Cu filter, 180 kv., and 2½ ma., and the time required is approximately fifty minutes. They expect to get a decided erythema each time. Treatment is repeated four weeks after the reaction has disappeared. In cases where the arm cannot be raised to apply the ray properly, they insert radium into the axilla.

At the Frauen Clinic in Berlin, Prof. Bumm and Prof. Warnekros use large fields. In uterine carcinoma they take a far field from the front and back, and smaller nearer fields from the sides.

At the clinic of Prof. Franz, the treatment used is very similar.

In the technique used at the various clinics, you can readily see that there is the greatest divergence of opinion even as to the most important details. One insists on large and far fields, to get the benefit of a larger proportion of depth dose and greater amount of scattered rays. The other prefers concentration with compression to get nearer to the lesion. The filters vary from ½ to 1½ mm. Cu or zinc. Some insist on the importance of applying the entire carcinoma dose within twenty-four or forty-eight hours; others divide it over a period of one week. Still others divide it into four weekly doses. The ideas as to what constitutes an erythema dose differ widely. Some are satisfied with the slightest erythema; others insist on a very decided reaction. But the most serious and almost irreconcilable difference of opinion exists upon the question as to when an erythema dose may be repeated. Some clinics say surely not within six months; others repeat it in six weeks, and again at eight weeks, and one clinic applies an erythema dose every month for four or five successive months. This seems almost impossible, but the man who is doing it assured me that, in his opinion, it is a perfectly safe and necessary thing to do. All this leaves us very much confused as to what is really the best technique to follow. Some of the questions decide themselves. For instance, I cannot imagine that any of us would attempt to treat a patient for seven hours a day, for two or more successive days. Nor can I imagine the patient here who would submit to it. This decides the question of divided doses, and also that of filters, as it pretty well excludes the use of 1½ mm. Cu filters. As to the dosage, I think this should depend to a large

extent upon the individual case. We are justified in taking greater chances in cases that are apparently hopeless, and where only the most radical treatment may prove of value. As regards the time when an erythema dose may be repeated, I think this lies somewhere between the two extremes. I would very much hesitate to give four or five erythema doses at monthly intervals, nor would I think it essential to wait six months before repeating it, in case it seemed necessary.

As to the choice of cases, in most of the clinics I visited, I found that they have practically discontinued operating on all cases of carcinoma of the breast and the uterus. They claim that the results with radiation alone are far superior, that they get approximately 85 per cent of cures, including all variety of cases taken at random.

These two classes really make up the largest proportion of cases to which the treatment is best adapted. In malignant growths involving other organs the results are not as satisfactory. They are all very emphatic on the importance of never treating any type of sarcoma surgically, as the chances of metastasis are very much increased by any surgical interference. The non-operated cases usually do very well.

As to benign conditions, I almost think that we can do just as well with our present technique. For instance, the patients treated for a myoma usually menstruate once, twice, or even three times after the treatment. With our present technique, giving them one treatment a week for five or six weeks, they rarely menstruate more than once. The constitutional disturbances are decidedly less severe, and the treatment nowhere near as trying to the patient. The treatment may do well for out of town patients, where time is an important element to consider. Some of the treatments they are using I should be afraid to try. For instance, in leukemia, some clinics take a large field including most of the spleen, and give them 40 per cent of an erythema dose at one treatment. I have seen very marked toxic symptoms following considerably less ray than this. In the *x*-ray treatment of skin diseases I think we do at least as well. I saw them epilate the beard of a patient with a sycosis which took fifty minutes. This epilation here is usually done in eight or nine minutes.

I am not going into the question of apparatus, but I do want to say a few words about the tubes used, as this has a most important relation to the technique to be adopted. At present they are all working with either the Suderöhre, or the Coolidge type of tube, with an occasional Lilienfeld tube here and there. None of them will stand more than 2½ ma. at 200 kv., and are rarely pushed to more than 2-2 ma. For the past two months they have been making tubes of the Coolidge type that will stand a current of 4 ma. But these tubes have not been properly tested out yet as regards their durability. Dr. Coolidge here has perfected a tube that will carry 8 ma. at 200 kv. If this tube will stand the test of time, I consider it one of the most important advances made in this field, and it will put us decidedly ahead as far as tubes are concerned. The time mentioned, as required for an erythema dose at the different clinics, was based upon the use of tubes carrying about 2 ma. With a tube able to stand 8 ma. we can cut the necessary time to one-quarter. This permits us to choose any one of the techniques described.

As regards the future of this "intensive therapy" I do not think there is the slightest doubt that it has come to stay. It is not a fad but is founded on carefully worked out scientfic bases. In fact, I feel quite certain that in time they will be using currents of even higher intensity. In a number of clinics they are even now installing machines that are capable of delivering up to 300 kv. and are merely waiting for tubes that will stand up under this currrent to begin using them. There is no doubt that in some cases of malignancy it shows results that with our present technique are impossible. For instance, I saw a patient in Berlin at the clinic of Prof. Warnekros who was treated four years previously for an inoperable carcinoma of the uterus, involving the fundus, both parametrium, with deep seated pelvic and inguinal glands. On examination I found the uterus freely movable, with no sign of any thickening in any part of the pelvis that I could find. She had gained 50 lbs. since the treatment, and looked the picture of health, a result that with our present technique seems too good to hope for.

THE TREATMENT OF CANCER OF THE RECTUM BY RADIUM*

By DOUGLAS QUICK, M.D.

Attending Surgeon, Memorial Hospital

NEW YORK CITY

IN reviewing our work of the past few years in rectal cancer it would be useless to attempt a statistical report, for various reasons. Most of the cases treated have been far advanced in the course of the disease and, while valuable information has been obtained from the radium standpoint, the most that could be hoped for from the patient's side was a certain degree of palliation. The lapse of time over which statistics become of real value has not been great enough. Furthermore, changes in technique have been steadily taking place so that our earlier work represents in no way what we feel we can accomplish at the present time. This is especially true of the past year.

We are stimulated by the surgical results to date to look for another method of treating rectal cancer and our experience with radium encourages us in proceeding along the present lines.

It is true that during the past few years surgical technique has improved and the operative results are consequently better. Even with this, in the hands of the most experienced operators, the results are poor and the operation a very mutilating one. More important than this however is the fact that a large number of patients are inoperable when seen by the surgeon. Statistics are not voluminous on this point but it would seem that over 30 per cent are inoperable in the opinion of the most radical operators when first seen. Rennington[1] quotes from the experience of Tuttle and Lynch over a period of nineteen years that 153 out of 491 cases were inoperable. It is deplorable that so many cases are looked on as hemorrhoids until the disease is far advanced. Lynch[2] found this to be true in 10 per cent of his series, while Rennington[1] quotes Jones as estimating it as high as 75 per cent. In our own experience it would seem that this error was made in well over 50 per cent of all cases. I believe there is no excuse for such errors if the patient's symptoms are considered seriously and a proper examination made.

From an analysis of surgical statistics it appears that the average operative mortality in the best hands ranges from 16 per cent to 20 per cent. Lynch[2] reported 16 per cent in a series of 491 cases. In a series of collected statistics embracing 1665 cases, Hartman[3] found the operative deaths to be 15.8 per cent and from another series Rennington[1] reports 12.5 per cent to 17.5 per cent with improvement in the later years. Hartwell[4] reported 26 per cent in 1905 and Mayo[5] 15.5 per cent in 1912. From a series of 1244 cases by fourteen selected operators Lusk[6] reported a rate of 19.7 per cent. Sepsis accounts for a great deal of this immediate mortality and fortunately it has improved in later years. In his report in 1905 Hartwell[4] placed it at 60 to 70 per cent, and in 1918 Rennington[1] quoted a rate of 39.8 per cent.

In the surgical literature we find considerable use made of the term "cure" as based on a three-year period of observation. I think it would be much better to refer to the result as apparent freedom from disease or "clinical cure" for a fixed period.

Based upon this three-year period of observation Mayo[5] had 33 per cent of operated cases well for 3 years; and 28 per cent over a five-year period. Rennington[1] reported 218 out of a collected series of 966 cases well for three years—about 22 per cent. Hartwell[4] reported 15 to 20 per cent for this period and Grant[7] 16 per cent "permanent recoveries." In his collected series Lusk[6] found 16.7 per cent well for the three-year period. Lusk[6] also quoted Baisch as authority for the fact that from a selected series of cases where careful microscopic examinations had been made, one-third of the cases that were other-

*Read at the Sixth Annual Meeting of THE AMERICAN RADIUM SOCIETY, Boston, June 6-7, 1921.

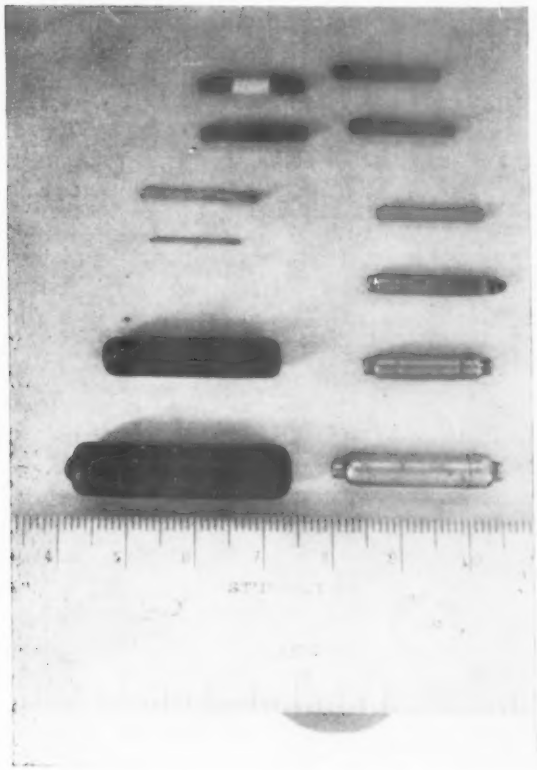


FIG. 1. Showing various tubes, both filtered and unfiltered, used in rectal work.

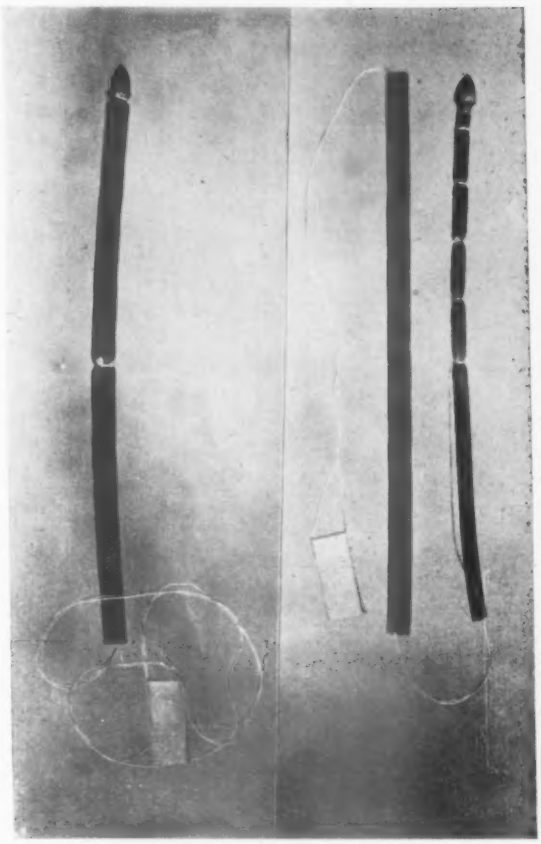


FIG. 2. Showing double rubber casing, with metal cap to facilitate introduction of annular growths of rectum.

wise operable showed involvement present in the glands.

A fair résumé of these statistics would then give us the following results. At least 30 per cent of cases are inoperable when first seen by the surgeon. Of the operable group the immediate mortality is at best about 16 per cent. The cases found clinically free from disease at the end of three years average below 20 per cent although a few selected groups are reported over 30 per cent.

Granting, therefore, a generous margin of doubt in favor of the surgical procedure we find that in the best hands an average of 14 per cent of all cases coming to the surgeon are free from disease at the end of three years and we know of course that this rate is lowered with each succeeding year.

This procedure entirely leaves out 30 per cent of the cases to begin with, or gives only a colostomy for relief where it is indicated. It brings to an abrupt end about 16 per cent of the operable cases. In the light of Lusk's report on gland involvement a radical procedure is begun in 1 out of 3 cases, which it is useless to attempt to complete. It seems unquestionable that many of the cases are rendered more comfortable for their remaining period of life when we consider the physical and mental shock of such a radical procedure, the suffering from sepsis in many and in many others the discomfort of a rectal stoma that does not function comfortably.

Since nearly all malignant lesions of the rectum are either adenocarcinomas or epidermoid carcinomas we have a certain amount of knowledge of their response to radium from experience with the same types of growths in other parts of the body. The problem is therefore largely one of technique. Unfortunately this is not as simple as it might seem.

In attempting to adapt our technique to the individual case we must have in mind something of what we may reasonably expect to accomplish. A review of our work to date may aid in formulating some such plan.

We have treated in all 161 cases of rectal cancer at the Memorial Hospital during the past four years. Of these practically all were very advanced cases: many hopelessly disseminated, others advanced recurrences. About 40 per cent of the group represent eleventh-hour efforts to try a new remedy, and, as I look back over them, I feel sure they would have been better off had no treatment with radium been given. There comes a time in the course of malignant disease when even the physical agents are of no avail.

A large number of cases have been benefitted from one to three years and then died of distant involvement or some intercurrent disease; others are still improving, and some with a fair hope of complete regression of the disease, providing there is not already distant metastasis. By improvement I mean inhibition of the growth, very frequently decrease in its size, with fibrosis which tends to create a local process rather than an actively growing disseminating one. The decrease in size relieves the partial obstruction; constipation is therefore less marked. Bleeding is largely stopped, discharge of mucous is lessened and pain is very materially decreased. With a certain amount of surface healing and deeper fibrosis the amount of septic absorption is lessened. This results in a gain in weight and strength and a general feeling of well-being otherwise not experienced by the patient. In a few cases the palliative relief has been prolonged over periods of up to three years so that patients are able to go about their daily duties practically symptom free, although we know from periodic examinations that malignant tissue is still present.

Fourteen patients only out of the entire series are now clinically free from disease for periods ranging from four months to four years. Two of these cases were granulomas of the type of lymphosarcomas while the others were typical adenocarcinomas or epidermoid carcinomas. The oldest case now free from disease for about four years has a marked fibrous tissue stenosis due to overradiation with heavily filtered radium placed within the lumen of the gut. This error we feel we can now safely eliminate by proper protection. Another case treated over a year ago had an annular growth about 6 cm. in diameter of the lower sigmoid; operation was advised against because of a high percentage of blood sugar; and following two treatments with radium he has now been entirely free from any evidence of disease for nearly a year. No stricture is palpable and the patient has no symptoms. The result is of interest because of the complicating diabetes.

A type of case that had been very discouraging to us, until the past year, was the bulky infiltrating growth low down in the rectum and frequently involving the sphincter. Under radiation it appeared to improve for a time and then broke down causing profuse discharge externally and usually with a loss of sphincter control. Five of these cases have been treated with very large doses of both buried emanation and surface radiation followed by local excision two to four weeks later. All 5 cases have remained free from disease now for periods ranging from seven to fourteen months.

During the past year we have been impressed by the number of cases that seemed to improve for a short time and then distant metastases, usually in the liver, became evident. Under such circumstances it is quite evident that the initial discomfort resulting from intense radiation of the local lesion is not warranted if the disease has already become generalized. In view of this we now feel that an exploratory laparotomy is justified in most instances where the local growth presents possibilities of complete regression from the use of radium. In the first place it permits of a complete examination of the growth. If extension has taken place it saves the patient the intense discomfort of an intense local treatment. If the lesion is one which warrants radical treatment with radium it is frequently an advantage to bury emanation into the growth from above, thus insuring a much more accurate application. If a colostomy is indicated and advisable it can be done at that time.

In a number of instances this procedure has saved the patient a great deal of useless radiation. We have been much surprised to find how frequently distant metastases were present with a relatively small primary growth. We have not depended entirely on the presence of enlarged glands to dissuade

us from radical treatment, subsequently, because a certain number of these are inflammatory; but in practically every instance where the glands were definitely involved the liver was also extensively involved. In these cases no radium was used locally. In some, radium and *x*-ray were used externally as a palliative measure.

We have not done a colostomy as a routine procedure. Lynch[2] feels that early colostomy in inoperable cases is as vital as early operation in operable cases. I cannot agree with either his premise or corrollary. It is quite true that a short-circuiting of the bowel relieves the growth from irritation and permits of more careful cleansing. On the other hand an artificial anus on the abdomen is far from pleasant. Many cases would be broken in spirit and lose their morale with the presence of such an objectionable opening. Many can be handled very efficiently and comfortably without it. I would urge a colostomy only in the case where radium application would be facilitated by it and where the possibilities of closing it after treatment were good. In impending obstruction it is of course imperative. In the large group of advanced cases who can control bowel function fairly well we leave the decision to the patient.

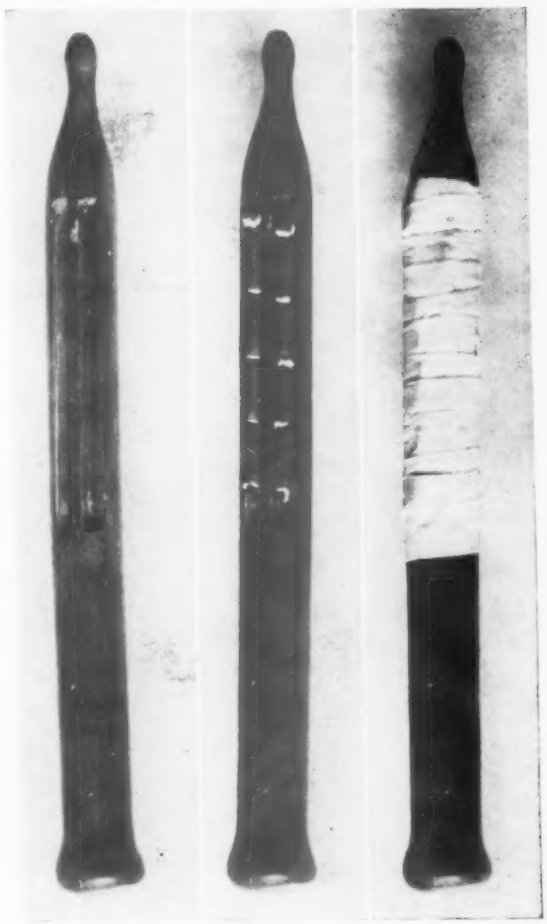


FIG. 3. Flexible type of rubber bougie applicator designed to afford protection for the uninvolved rectal wall in growths confined to one side.

TECHNIQUE OF RADIUM APPLICATION

The literature affords very little aid in dosage and technique of radium application in rectal cancer. Our own experience has been one of gradual change from applying filtered radium internally only, to a combination of buried emanation, filtered radium internally and externally and, if necessary, surgical exposure to make the application as accurately as possible.

At first we used only one tube of 1 mm. platinum filter in rubber inserted into the stricture or packed against the lesion with gauze where the growth did not involve the entire circumference of the gut. Following this we used tubes of the same filtration but arranged end to end in tandem fashion, enough to extend beyond the limits of the growth above and below. These were inserted in a small rubber tube inside a larger rubber rectal tube to afford some distance, because we soon learned that the rectal mucosa did not stand radiation nearly as well as the mucous membrane in other parts of the body. This factor of irritation of normal rectal mucosa has rendered the treatment of cancer in this location much more difficult than it otherwise would be.

In 1917, we began using radium emanation interstitially and in a previous publication Janeway[8] has mentioned its use in connection with rectal cancer. This method has added more to our improvement in results than all other changes combined. It permits of distributing the radiation throughout the growth so that an accurate approximation can be made. It permits of using both the beta and the gamma radiation thus resulting in a saving of radium energy. It can be introduced into the upper portion of a growth through an abdominal incision and left in

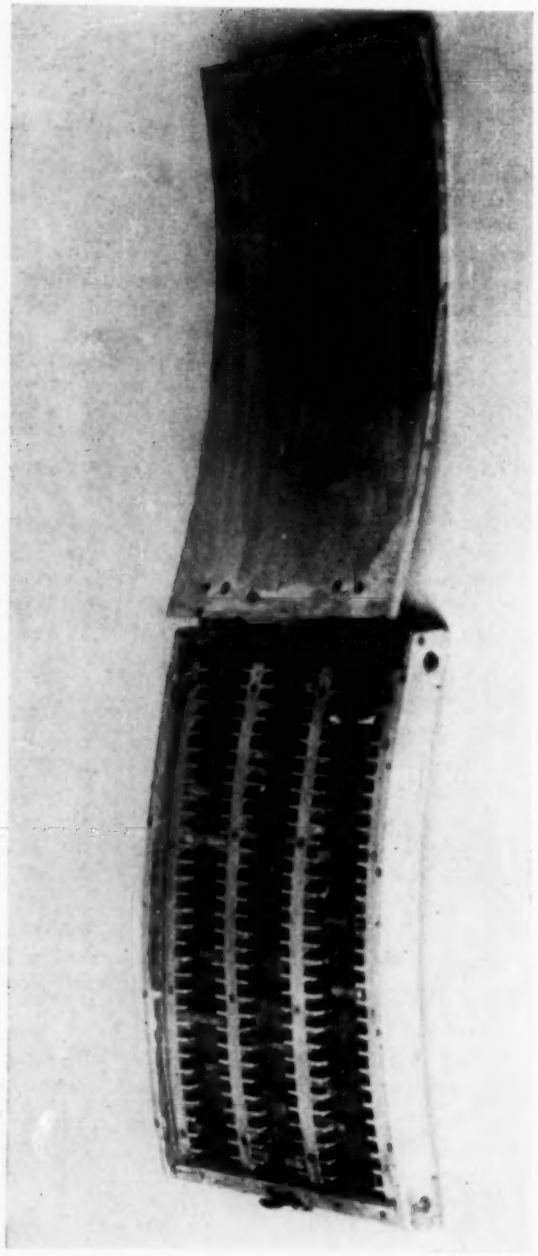


FIG. 4. Radium emanation "pack" used in applying heavily filtered doses over the sacrum.

situ. It permits of a continuous radiation over a period of a few weeks thus resulting in greater dosage being possible than where filtered tubes or needles containing radium element are inserted for a few hours and then withdrawn. These emanation tubes may be inserted, by means of the usual trocar needles, through the proctoscope or as I frequently prefer, if the growth be low down, through a small cannula which is inserted alongside the examining finger. Palpation is always more important than direct vision in inserting radium emanation tubes. The tubes are about 3 mm. in length and 0.3 mm. in diameter and so far we have observed no ill effects from them as foreign bodies. In our earlier work we used tubes of too great strength but now we have reduced the strength of individual tubes and can thereby get a more uniform distribution by using a greater number of tubes. At present we are using tubes of about 1 mc. although in some very bulky growths it is quite safe to use tubes up to 2 mc. in strength. One mc. of radium emanation left in situ until exhausted gives a total radiation of approximately 132 mc. hrs. Depending upon the size and distribution of the growth our dosage of buried emanation varies from 10 to 40 mc. or a total of 1320 to 5280 mc. hrs.

It is frequently possible to introduce these tubes into the rectal tumor without anesthesia because the pain is very slight but I am in favor of a short gas and oxygen anesthesia in most instances. The relaxation by the anesthetic permits of a more accurate distribution of the tubes.

With the early use of buried emanation we fell off very sharply in the use of filtered radium internally. We soon found that this was a neglect of opportunity to get in an appreciable quantity of radiation at close range, and have resumed its use. Where the growth is annular a string of ½ mm. platinum tubes, usually 3 to 5, arranged end to end in a small rubber tube which is again encased in a larger rubber rectal tube with a metal end to facilitate introduction, is placed within the stricture. They may be inserted directly or through the proctoscope. A sufficient number of tubes should be used to go beyond the limits of the growth both above and below. Using this filtration and protection a dosage of 500 mc. hrs. per tube does not give an undue reaction. Where the growth is limited to one segment of the rectal wall a slightly different type of applicator is employed. Solid rubber rectal bougies of various sizes with two grooves cut in the side are employed. In these grooves the required number of platinum tubes in small rubber tubes are placed. Knowing the axis of the growth and its distance from the sphincter

it is possible to insert this applicator so that the tubes come in accurate and close approximation to the growth. If necessary it may be rotated in order to complete the application. This applicator has the advantage of protecting by distance the opposite uninvolved rectal mucosa from the full dose of radium used over the growth. We now feel that it is a distinct advantage to use an internal dose of filtered radium before burying emanation tubes throughout the growth. The surface radiation applied in this way inhibits the growth and produces at least a temporary retrograde process during the course of which it is safer to introduce the needles carrying emanation tubes. The theoretical danger of dissemination by trauma is thereby obviated or materially lessened.

Carcinoma low down in the female rectum offers a more favorable opportunity for treatment because it can be reached through the posterior vaginal wall. For this purpose we use small 2 mm. lead or brass plaques of about 4 sq. cm. surface area as the filtering applicator. One, two, or three of them depending on the individual requirements may be placed over the posterior vaginal wall and the other walls packed away with gauze packing. It is best to separate the plaques about 1 cm. from the posterior vaginal wall and at this distance 800 mc. hrs. per plaque with the lead or slightly less with the brass, can be given with safety in addition to that already used within the rectum. This adjunct is of most value of course where the growth is low down and involving the anterior rectal wall.

At first we were disposed to apply all of our treatment from within but more recently we have been convinced that it is necessary to attack rectal cancer from every available angle if we are to hope for complete regression of the disease with any degree of uniformity. We have therefore resorted to heavily filtered doses of radium applied at a distance from the skin over the sacrum and, if the growth be higher up, through the left lower quadrant as well. For this purpose our usual 70 sq. cm. radium pack is used. This pack is filtered by 2 mm. of brass, and at a distance of 10 cm. from the skin 20000 mc. hrs. of radiation can be given with safety. We feel that this adds very materially to the ultimate result.

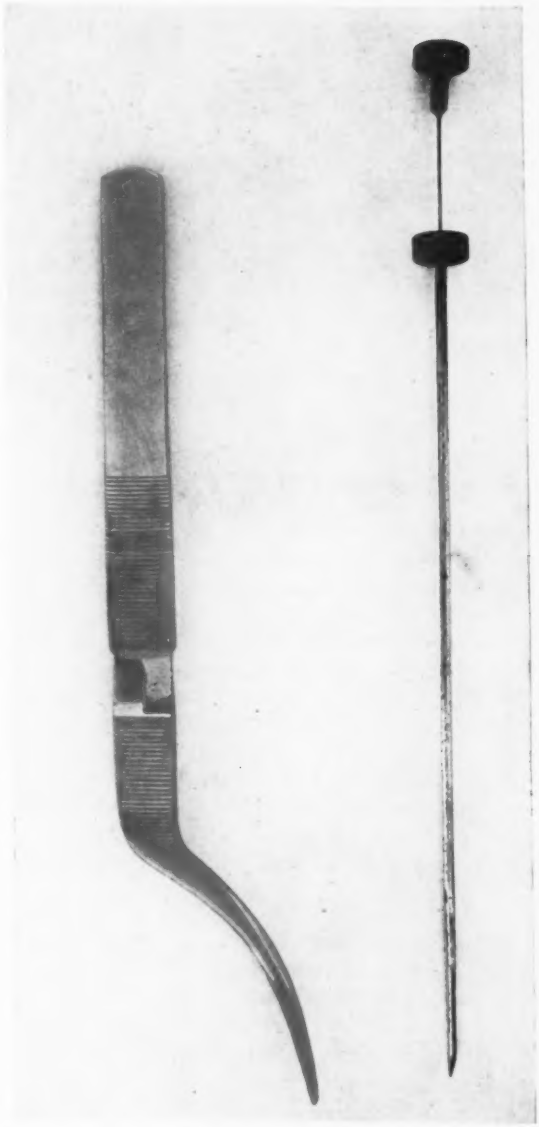


FIG. 5. Showing unfiltered radium emanation tube, trocar needle, and forcep used in placing tube in end of hollow needle.

While our dosage has always been directed toward giving as much as possible with a given applicator, our technique, it will be seen, has changed very materially in the past year. We feel that with this effort to deliver as much radiation from as many avenues of approach as possible in the cases for whom we hold out a possibility of complete regression, our results have been much more encouraging.

FIG. 6. Microphotograph showing early changes due to external radiation on rectal cancer.

FIG. 7. Microphotograph showing marked degenerative changes due to burying radium emanation within the growth.

PRESENT CONCLUSIONS ON METHODS OF TREATMENT

Every case of rectal cancer presenting for treatment should be classified in one of three groups depending on extent of primary growth, metastases or probability of metastases, age and general physical condition.

GROUP I. All cases for whom a reasonable hope for complete regression can be entertained.

FIG. 8. Microphotograph showing degenerative changes and fibrosis two months after burying radium emanation in rectal cancer.

GROUP II. Advanced cases for whom a reasonable hope for palliative relief can be entertained.

GROUP III. Hopelessly advanced cases for whom the physical agents hold out no chance for relief.

Such a classification is of course very vague and with further improvement in technique will be gradually changed.

However, some such scheme must be adhered to in order to formulate a plan of treatment for each individual case.

It is only human to suppose that Group III will always be with us but let us hope that with better medical education, lessening of fear and distrust on the part of the patient, and improvement in technique with the physical agent it will be steadily reduced. For these patients with disease far advanced both locally and regionally, and with general physical condition markedly deteriorated it is better to do nothing except to pay attention to hygienic measures and medicinal relief. An occasional colostomy may of course be necessary but this should be decided on the merits of the individual case.

In Group II we should give first consideration to the comfort of the patient throughout. If surface applications of radium internally will relieve discharge, bleeding, pain and obstruction and prolong life then it should be employed with that end in view

but not pushed to the point of serious discomfort. I believe that in these cases buried emanation should be used sparingly, if at all. The reaction from it in large doses is too severe to warrant its use for purely palliative relief. In some cases a colostomy may be an urgent necessity but as a general rule it should be left to the decision of the patient, after he has been acquainted with the facts.

In Group 1 we should make use of radium in as large doses as possible and through all available channels to effect a complete regression. In the majority of these cases I am convinced that an exploratory laparotomy is advisable. It can be done usually under local anesthesia with very little risk to the patient. It establishes definitely the advisability or not of pursuing radical treatment. It frequently offers a much more accurate means of introducing radium emanation into the upper portion of the growth. If it is found that a temporary colostomy will facilitate treatment it can be done at the same time. In many of the smaller growths a laparotomy is not essential for localization of the disease. They can be treated very accurately through the proctoscope and a colostomy need not be considered. In these therefore we can afford to gamble to a certain extent on the absence of regional or distant metastases. Treatment of these smaller lesions is not attended by an appreciable amount of discomfort but I feel that we are fully justified, in the light of our present experience, in subjecting a patient to this where there is a reasonable hope for complete regression of the disase. Emanation in sufficient amount should be distributed accurately and uniformly throughout the growth, preferably under gas and oxygen anesthesia. Filtered radium should be applied internally in every way that the anatomical relations of the individual case permits. Filtered radium should be applied at a distance from the skin and in maximum dosage over the sacrum and, if the growth be high up, over the left lower quadrant as well.

In certain cases, especially bulky growths involving the small sphincter, surgery may be employed to advantage after intense radiation.

I have made no mention of surgery for the so-called strictly operable cases. The statistics of surgery alone in these cases are before us and leave much to be desired. Unfortunately sufficient time has not elapsed to permit of radium statistics from improved methods of application.

We feel, however, that our experience throughout this period of evolution in technique and methods of radium application warrants us in treating the operable as well as some of the more advanced cases, with a reasonable hope for success.

BIBLIOGRAPHY

1. Rennington, J. R. The end-results of operation for cancer of the rectum. *J. Am. M. Assn.*, Dec. 7, 1918, lxxi, 1892.
2. Lynch, J. M. Cancer of the rectum and pelvic colon. *J. Am. M. Assn.*, Nov. 24, 1917, lxvix, 1775.
3. Hartman, H. *J. de Chir.*, 1913, xi, 693.
4. Hartwell, J. A. The radical treatment of cancer of the rectum with particular reference to the value of inguinal colostomy. *Ann. Surg.*, Sept., 1905, xlii, 399.
5. Mayo, Wm. J. The radical operation for the relief of cancer of the rectum and recto sigmoid. *Ann. Surg.*, 1912, lvi, 240.
6. Lusk, W. C. Excision of the rectum for cancer. *Surg., Gynec. & Obst.*, Aug., 1908, vii, 113.
7. Gant, S. G. Cancer of the rectum. *N. York M. J.*, July 21 and Aug. 18, 1906, lxxxiv, 111, 319.
8. Janeway, H. H. Treatment of cancer, particularly of the tongue, tonsil and rectum, by buried emanation. *Am. J. Roentgenol.*, Feb., 1920, vii, 92.
9. Ewing, J. Neoplastic diseases. Phila., 1919, p. 648.

DISCUSSION

Dr. Henry K. Pancoast. Dr. Quick has given us an excellent presentation of the technique of the treatment of this condition as it should be carried out. I doubt if any of us have carried out as thorough a technique in the treatment of carcinoma of the rectum as has been given. We all realize that carcinoma of the rectum, as it comes to us, is a usually hopeless condition. It is a very good example of the necessity for early diagnosis when such cases can be treated successfully, if ever. How often is the patient who has a little bleeding from the rectum and pain given a salve and told to take some other treatment for hemorrhoids instead of a careful examination being made? Certainly women who complain of persistent bleeding from the uterus are not given such treatment, and there is just as much necessity for paying attention to these cases of rectal bleeding as to the uterine.

So the cases that come to us are usually palliative and the treatment must be palliative to relieve the patient to a certain extent. Take the latter class first. All we can do is to keep the passage open for as long as possible and keep the patient comfortable. We can do this in most cases for a comparatively long time. Dr. Quick has said for two years, and I can bear him out in this statement. If we regard the case as a little more favorable, and yet it is still palliative,—we must regard the cases from all points of view. One of the most important points is free access to the growth. In the treatment of carcinoma of the face or mouth we expect to have free access, and we need this in the rectum just as in any other part of the body to get the best results.

I think the preliminary laparotomy is of great importance, and a procedure we have not carried out except in one or two instances. In one of these we were amazed to see the extent of the growth, and we had to let the patient go practically untreated. I do not doubt that many cases which we have treated as rectal carcinoma also have widespread metastases in the pelvis and even up in the liver. Such cases are usually better off without radiation, but simply a colostomy to relieve the pressure and obstruction. If metastases extends into the prostate and bladder it is folly to treat such cases for they will be made more uncomfortable by any sort of treatment.

Our statistics cover 15 to 20 cases, and in thinking over those cases to decide whether it was better to do anything, we can pick out say 4 out of 16, or 25 per cent, in which we feel we have done the patient some good. One patient is still living following a colostomy five years ago. Another patient was free from symptoms for about three years when there was a recurrence from which she subsequently died. Another patient has been kept in comparative comfort for three years by the introduction of tandem tubes to keep the stricture open. We did not attempt to do anything further and he has movements every day if the stools are kept soft. Another patient has been kept well for five years and is able to ride around on a bicycle and has reduced his morphine from 20 grains to 2 or 3.

As to the technique, I am glad to hear, as a preliminary part of the technique, of the exploratory laparotomy which I think is well worth while; then a colostomy if it is needed; then free access to the growth, whatever that may mean. It may mean partial surgery, it may mean introduction of the needle from above, if necessary, and this cannot be done unless one uses emanation tubes, which I have not been able to do. If the growth is annular, the tubes must be used in the lumen and one must watch the remainder of the rectum. We must look for metastases, and I think no case is properly treated without cross-firing with *x*-rays, from both front and behind. Whatever treatment we can give inside is only part of the treatment and we must depend upon cross-fire radiation from the outside to supplement it.

Dr. George E. Pfahler. I have only had experience with inoperable cases. I think all of these are undesirable cases as far as the pleasure of working at them is concerned, and because the outcome of any case of carcinoma of the rectum is likely to be unfavorable, but I have used a combination of methods that has not been mentioned, and it is for that reason that I speak.

In 3 different cases I destroyed the growth locally by means of electro-coagulation, and in 2 of these cases I then introduced a radium pack or tampon similar to the one described by Dr. Quick and treated them by cross-firing with the *x*-rays externally. One patient lived three years and then seemed to die of toxemia. He had a marked stricture of the rectum and I believe his death was due to toxemia from retained feces. This man had had three operations before he came to me and would not permit another. The second patient who was treated by this method for a year has been attending to his usual duties which are rather strenuous. He has a stricture of the rectum so that the lumen is perhaps ½ or ¾ of an inch. Aside from that he is free from symptoms and goes about his duties. We must expect a constriction that will result both from scar tissue and radium application. The third case I treated by this combination is more recent and is doing well and I believe it is a form of treatment I would use again.

I first radiated to the limit of skin toleration externally, requiring a period of two weeks. Then I destroyed the growth, which was approximately three inches in length and about two in width and filled the rectum, by means of electro-coagulation. Then immediately in the pieces of this tumor, or what was the tumor, I introduced 150 mgm. of radium in the form of needles, and a week later introduced a radium tampon and we shall follow up that by cross-firing with the *x*-rays, which I believe gives us a very good method of treatment.

Dr. H. H. Bowing. I wish to mention another type of anesthesia. That is caudal or sacral anesthesia, which we feel is very helpful.

One of the elements of failure in the treatment of these cases is the poor exposure of the lesion afforded by ordinary methods. Caudal or sacral anesthesia is a very satisfactory procedure. The technique at the Clinic is that of Dr. Labat. It not only assists the operator but offers in many ways relief of pain to the patient. Owing to the liberal amount of sphincter relaxation, an extra large proctoscope is used. Following the radium application in some of these cases, the exposure of the lesion was so complete that it seemed efficacious to give *x*-ray treatments through the proctoscope. Time intervals are too recent to determine the result in this type of therapy.

Dr. R. E. Loucks. We have considered the treatment of the disease very well, but aside from that I think we should treat the patient. I think if any patient suffers it is the one with proctitis, especially from radium. The colostomy gives us a good source for irrigation of the lower bowel, and I have found that it affords the patient great comfort to give an irrigation at least twice a day with an alkaline solution. I have found that a solution of boracic acid or chlorate of potassium has given these patients much comfort. Then sometimes, as you know, we have to resort to opiates, but the treatment with morphine gradually creeps up, so we use morphine by suppositories.

I think the after-treatment is of much importance, for these patients suffer a great deal. They have an inflamed condition and a great deal of secretion from the cells and this produces much discomfort in the external folds of the anus.

The diet in these cases is another consideration. I think the diet should be regulated. The idea of allowing people who have a proctitis to eat all kinds of highly seasoned foods is a mistake. If we had a diseased eye we would have it covered up, but if the rectum is involved we often allow patients to eat anything they wish and it sets up a great deal of irritation. They should have plenty of food and alkaline fluids.

Dr. Douglas Quick (closing the discussion). I think Dr. Loucks summed the whole thing up when he said "treat the patient". I think a great deal of the treatment is in keeping the patient comfortable. It is just for that reason that I urge classifying these cases before we start and not starting at random and seeing where it leads us. There are certain cases in which I think we can reasonably hope for complete regression. These people I think we should treat to the limit. They do suffer, there is no question about that. They have pain, they lose some weight, have marked toxemia, and that sort of thing, but that I think is well worth while if we have some light on the other side to look forward to. In these cases I want to urge again the exploratory laparotomy to see where we are. Just a few weeks ago we had four cases in one week in whom we did exploratory laparotomy, and three had extensive liver metastases. I think it would have been a shame to put these patients through the radical treatment, which would have caused them great discomfort. There are some cases with the small early lesions, in which the suffering is not so marked.

I wish to congratulate Dr. Pfahler on the use of electro-coagulation, and this is one class of cases in which I think we should get very good palliative results with a minimum amount of discomfort.

The use of *x*-rays externally, as mentioned by Dr. Pancoast, is followed by us and we have had some results. In the group which we look upon as favorable we have tried to use as much radium as possible.

PATHOLOGICAL CLASSIFICATION OF THYROID GLAND DISEASES WITH RADIUM TREATMENT IN TOXIC GOITER*

By R. E. LOUCKS, M.D.

DETROIT, MICHIGAN

IN this day of distinctive entities it is absolutely essential that a disease of certain glands or organs should be classified according to the pathological condition present. Whether it is acute, subacute, or chronic is another important consideration.

In diseases of the thyroid gland it is imperative to have three general classifications

*Read at the Sixth Annual Meeting of The American Radium Society, Boston, June 6-7, 1921.

with one or two subgroups following each class.

1. Inflammations
   (a) Acute purulent thyroiditis (rare)
   (b) Tuberculosis of thyroid
   (c) Diffuse interstitial thyroiditis
   (d) Interstitial thyroiditis as in pellagra
2. Tumors
   (a) Carcinoma
   (b) Carcinoma sarcomatodes
   (c) Sarcoma
3. Dystrophies
   (a) Colloid retention hyperplasia
      1. Colloid goiter (diffuse)
      2. Circumscribed colloid adenomata (cystic)
   (b) Proliferating type
      1. Adenoma
      2. Fetal adenoma
      3. Adenoma with toxic changes
      4. Primary exophthalmic goiter as a selective type.

For a clinical classification of hypo- and hyperthyroidism we are indebted to Plummer who groups them as follows:

1. Hypothyroidism
   (*A*) Cretinism
   (*B*) Myxedema
2. Hyperthyroidism
   (*A*) Thyrotoxic adenoma
   (*B*) Exophthalmic goiter
3. Nontoxic Enlargements
   (*A*) Adenomas—nontoxic
   (*B*) Adolescent goiter
   (*C*) Colloid goiter

As we are to discuss the treatment of the toxic or active type of this gland it would be fitting to enumerate certain toxic changes and emphasize the cardiac and general degenerations. Whether there is a selective poison to produce a primary exophthalmia in one case, and an active thyrotoxic adenoma with exophthalmic symptoms in another, we shall not discuss here.

The toxic adenoma produces a sequence of symptoms different from the exophthalmic type. There is no sudden exacerbation but a general increasing chain of symptoms over a period of years, after the enlargement of the gland is noted. It may have started in the teens and existed many years before toxicity was observed.

Exophthalmic goiter with few exceptions runs a typical course. The thyroid gland may not show any enlargement, or a very slight one at first with mild toxic symptoms which gradually increase in severity until about the eighth month, when they are markedly worse; this is commonly known as a crisis. After this explosion of symptoms, there is improvement with fairly constant symptoms, until the end of the second year, when a second crisis occurs. Hereafter the active symptoms may subside slightly, or run an up and down course. The individual may exist as a human wreck for years, or the cardiac and general degeneration progress so rapidly as to cause termination of life.

The thyroid is termed the principal "regulator of metabolism." It is the main link in the chain of endocrinal glands.

The clinical manifestations of thyroid activity may be corroborated by means of one of the metabolor apparatus.

The process of combustion within the body depends upon the intake of the essential element, oxygen. The physics of physiology has standardized this oxidation with its output of carbon-dioxide (at a certain temperature standard and barometric pressure), so that the caloric value of oxygen may be determined.

With hyperactivity of the thyroid there is marked increase in cellular activity with a speedy demand for larger oxygen consumption. To estimate the rate it is only necessary to measure the amount of oxygen consumed in a given period of time and make your calculations by physiological standards for body surface, temperature and barometric pressure.

This will give the number of calories per square meter per hour, and is known as the "metabolic rate." With forty as the standard, and knowing that there are normal variations on account of age, seasonal and climatic variations, an allowance of 10 per cent, either above or below, is recognized.

With hyperactivity, the basal metabolic rate is increased in proportion to the clinical evidence of toxicity. McCaskey says: "The value of basal metabolism determinations in proving the pathogenic role of thyroid hyperactivity has been confirmed by additional experience. Probably more than 90 per cent of all cases showing increase in

metabolic rate are due to hyperthyroidism. Other endocrine glands play a small subordinate role".

The exophthalmic type at first gives a slight increase in blood pressure, which after the first crisis, falls to normal, or below normal, and again increases and remains high.

Etiology. There are many views and opinions on the cause of thyroid hyperactivity. "Thyroid centers" is a term used to designate certain locations, as Michigan, Minnesota, and Switzerland, where there appears a preponderance of the disease.

Fear, shock and violent emotions are factors that may precipitate an activity, but focal infections from tonsils, adenoids, duodenal and typhoid ulcers are apparently active causes. Many cases are associated with gastric disturbances or general ptosis of the abdominal viscera, also hypo- and hyperactivity of other endocrines at the time of puberty, pregnancy and the menopause.

Symptoms. It is unnecessary to go over the cardinal symptoms to the members of this society but I wish to state a few observations.

Look for an active thyroid with a patient having a florid, blotchy skin, tachycardia without organic heart disease, profuse sweating of the palms of the hands and soles of the feet, longitudinal striae of the nails, a choking or aching pain above the sternoclavicular articulation.

Many neurasthenics with low blood pressure associated with simple anemia, are found to have a high basal metabolic rate, and are the victims of slow toxic absorption from an active adenoma.

Forewarning symptoms of a bad prognosis are:—

1. Bulging eyes for two or more years.
2. Pale muddy complexion with edema of the extremities.
3. Pulse rate of 140 with irregularity, which is due to fibrillation.
4. High blood pressure.
5. Emaciation with a history of losing weight rapidly.
6. Strong apex impact with pulsation of the intercostal muscles over heart.
7. Cardiac dullness, increased with accentuation of last sound or both sounds of heart.
8. Apex beat counted as 180 with 120 recorded at radial artery .
9. Urinary symptoms of a failing heart muscle.
10. High basal metabolic rate.
11. Persistent diarrhea.
12. Cerebral symptoms and the presence of acidosis.
13. A positive Wassermann.

TREATMENT

The indications are only defined after all the facts have been considered and the case classified, unless some symptomatic relief is urgent. Commence with saline elimination (unless diarrhea is present), rest in bed, nonprotein diet, ice bag over thyroid gland and precordia, alkalines internally and alkaline sponge baths.

Strontium bromide may be tried, quinine hydrobromide, ergot, ergotine and sodium cacodylate. If after two weeks of medication with hygienic and dietetic measures, there are still decided evidences of thyroid toxemia you must choose between surgery, *x*-ray and radium.

The wave of opinion today among scientific research workers, is that toxic goiter is not a surgical disease.

After some years of experience and the assurance of my co-workers, I have arrived at the conclusion that radium is the treatment of choice. Aikins of Toronto reported at the meeting of the American Radium Society at New Orleans last April, 100 cases treated with wonderful results, and convinced the most skeptical of the merits of radium.

It is portable, less exciting, more easily controlled, does not produce a sudden toxemia, and results are more promising than with *x*-ray. Supplement your radium treatment with rest, protein-free diet, ice bag to thyroid gland and at times to precordia. Medicate for two weeks if necessary and use alkalies freely.

Radium Treatments: Use 100 mgm. (at least) in four tubes, each tube screened in 1 mm. brass and 1 mm. gum rubber. The screened tubes are placed on a gauze pad 2 cm. in thickness to get distance and protect the skin. Two or three ports are exposed over the gland, depending on the size of the gland, size of the pad and the amount of ra-

FIG. 1. CASE I. J. B.

dium used. The time of exposure varies from eight to ten hours over each port.

With your indulgence I will give brief histories of 5 cases treated, with metabolic readings before, and monthly readings for three months after treatment; also photographs of 3 cases before and after treatment.

CASE 1. (June 29, 1920). J. B., male, Solvay Process employee, aged twenty-nine, single. Occupation, repairman.

Complaint. Nervousness, weakness and loss of weight together with enlargement of neck.

Past and Family Histories. Negative

Present Illness. Entered the Solvay Hospital today. For the past six months he has been gradually getting nervous. His neck has also gradually increased in size although it was always large. His condition grew progressively worse, and during this time he lost 40 lbs. in weight.

PHYSICAL EXAMINATION

On admittance he was so nervous that his voice trembled and his jaw shook. Had an alert expectant expression on face. Eyes; —Pupils regular, marked exophthalmos with positive Von Graefe and Stelwagon signs, slight lateral nystagmus. Tongue had a marked tremor.

Neck. Marked enlargement of both lateral lobes of thyroid gland.

Heart. Slight enlargement. Distinct systolic murmur heard all over the precordium. Pulse regular, easily compressible with a rate of 130.

Hands and Fingers. Marked Tremor.

SUBSEQUENT RECORD

Blood counts and urinalysis were made and found normal. Wassermann gave a negative result. Goetch test gave a positive finding. He was nauseated from time to time and vomited occasionally.

On August 27th (two months), the superior thyroid arteries were both ligated and three-fourths of the right lobe and one-half of the left lobe removed. Temperature varied from 99 to 102 F. and he had a stormy convalescence.

He left the hospital October 15, 1920, somewhat better. Temperature was occasionally 99.2 F. with a pulse rate of 100 to 120. Neck showed evidence of increasing enlargement.

From October 15 to November 8, 1920, he lived at home but was treated with thyroidectine.

November 8th, he again entered the hospital for rest and a subsequent operation. His blood and urine were again normal. Caloric value was found to be 120. He was given a high carbohydrate diet, salt free, yet he gradually grew worse. Bromides and thyroid residue were tried but without results.

On January 31, 1921, he was referred to our service.

EXAMINATION

Has some temperature at times. Perspires considerably. Pulse varies from 100 to 130. Systolic blood-pressure, 142; diastolic, 70. Blood count: reds 4,980,000; whites 5,900; polynuclears, 50 per cent; small lymphocytes; 30 per cent; large lymphocytes, 19 per

cent; eosinophile, 1 per cent. Urine, normal.

Upper circumference of neck, 18½ inches; middle, 19 inches; lower, 19½ inches. Basal metabolism rate, 120.

Heart. Apex directly below nipple; cardiac dullness, extends toward the left; distinct systolic (mitral) murmur carried toward the axilla.

The pulse and heart sounds are characteristic of cardiac change besides the endocarditis.

Diagnosis. Exophthalmic hyperthyroidism of an old adenoma. 2. Chronic myocarditis. 3. Chronic endocarditis.

Prognosis. Control toxicity. Relieve work on heart and restore compensation. Reduce thyroid enlargement.

Treatment. Was given 220 mgm. radium in six tubes. Each tube screened in 1 mm. brass and 1 mm. gum rubber, all placed on a gauze pad 2 cm. thick and held over right lobe of thyroid for ten hours, and then over left lobe for ten hours.

March 1st. Eyes less prominent, thyroid smaller, softer, and does not cause tracheal pressure. Apex beat to right of nipple. Radial pulse and apex beat each 88. Systolic blood-pressure, 122; diastolic, 60. Metabolic rate, 68.4281.

Basal Metabolism—March 8, 1921.

Time	*Reading*	*Barom.*	*Temp.*	*Height*	*Weight*
10:14	5150 cc.	29.03	20	5:05½	150
10:20	2650 cc.	29.03	20		
06 min.	2800 cc.	.007 Temp. Centigrade. 4.85 Calories per liter oxygen. 1.8 Body surface. (Du Bois Chart)			
1 hr.	28000 cc.				

April 8th. Upper circumference of neck, 17 inches; middle, 17½ inches; lower, 18 inches. Pulse 90. Systolic blood-pressure, 130; diastolic, 70. Metabolic rate, 53.7649.

Basal Metabolism—April 8, 1921.

Time	*Reading*	*Barom.*	*Temp.*	*Height*	*Weight*
10:30	6200 cc.	29.11	20	5:05½	150
10:36	4000 cc.	29.11	20		
06 min.	2200 cc.	.007 Temp. Centigrade. 4.85 Calories per liter oxygen. 1.8 Body surface. (Du Bois Chart)			
1 hr.	22000 cc.				

Two weeks following the first treatment he was better and had his clothes on. Was out of the hospital in four weeks and resumed work in the factory in six weeks. His eyes are less prominent; tongue and fingers more steady; tachycardia less. No nausea since the first week.

Recommended a second treatment. Was given 280 mgm. with the same screening and for the same time as on January 31st.

May 10th. All symptoms better. Pulse 80. Systolic blood-pressure, 120; diastolic, 70. Metabolic rate, 56.766, which is a few points above April 8th reading, and due to treatment four weeks ago.

Basal Metabolism—May 7, 1921.

Time	*Reading*	*Barom.*	*Temp.*	*Height*	*Weight*
10:49	6400 cc.	29.24	19	5:05½	151
10:55	4100 cc.	29.24	19		
06 min.	2300 cc.	.916 Temp. Centigrade. 4.85 Calories per liter oxygen. 1.8 Body surface. (Du Bois Chart)			
1 hr.	22300 cc.				

Case 11. (March 9, 1921). S. R., female, aged thirty, married. Occupation housewife.

Complaint. Enlarged neck and nervousness; duration three years.

Family History. Negative.

Personal History. Enjoyed good health until three years ago. Menstruated at eighteen years; always regular. Is the mother of two living children, one six and the other four years of age.

Three years ago she complained of pain around her heart and between her shoulders with loss of voice. She is disinclined to work; has difficulty in breathing and on going up stairs; perspires freely, has lost nearly all of her hair; is very nervous; appetite poor and sleeps very little. She has indigestion and constipation and falls down occasionally; is afraid to stay alone; lost about fourteen pounds in weight.

PHYSICAL EXAMINATION

Radial pulse rate, 100. Apex rate, 160. Systolic blood-pressure, 180; diastolic 90. Upper circumference of neck, 15½ inches; middle, 16 inches; lower 16½ inches. Weight, 158 lbs. Metabolic rate, 88.8282.

Basal Metabolism—March 7, 1921.

Time	*Reading*	*Barom.*	*Temp.*	*Height*	*Weight*
10:55	5600 cc.	29.31	20	5:07¾	153
11:01	2000 cc.	29.31	20		
06 min.	3600 cc.	.913 Temp. Centigrade. 4.85 Calories per liter oxygen. 1.8 Body surface. (Du Bois Chart)			
1 hr.	36000 cc.				

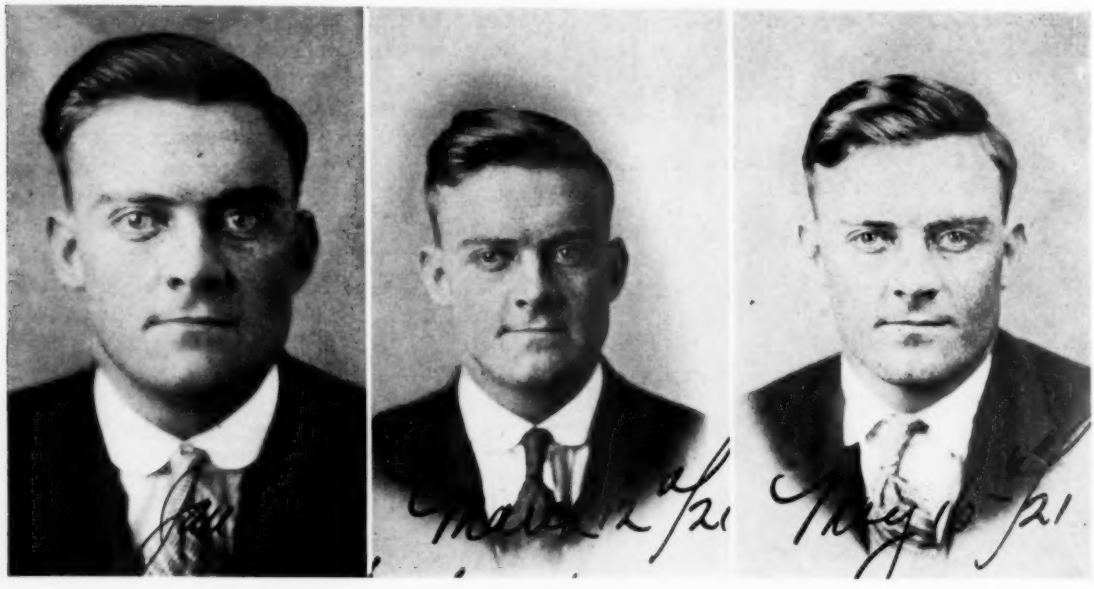


FIG. 2. CASE IV. S. H.

BASAL METABOLISM—March 31, 1921.

Time	*Reading*	*Barom.*	*Temp.*	*Height*	*Weight*
10:45	5800 cc.	29.22	21	5:07¾	148½
10:57	3200 cc.	29.22	21		
06 min.	2600 cc.	.910 Temp. Centigrade. 4.85 Calories per liter oxygen. 1.8 Body surface. (Du Bois Chart)			
1 hr.	26000 cc.				

Skin blotchy and moist. Perspires so freely that adhesive tape would not hold. Tongue tremulous. Thyroid enlarged with the right lobe larger than the left.

Pulsation seen along the great vessels of the neck and a bruit heard over the left lobe of the thyroid.

Anterior left chest heaving with every heart beat and pulsation seen between the ribs overlying the heart. Heart sounds so rapid that it was hard to distinguish a murmur at the apex which was referred toward the left axilla.

Fingers crooked in a flexed position with a marked tremor on extension. Nails of a poor quality and striated.

Diagnosis. Exophthalmic hyperthyroidism (having passed the second crisis).

Prognosis. Control the toxic symptoms and lessen heart activity, and thus make her more comfortable and prolong life.

Treatment. Was given 180 mgm. of radium in six tubes, each screened in 1 mm. brass and 1 mm. gum rubber. Made into a gauze pad 2 cm. in thickness and applied over each lobe of the thyroid for ten hours; total of twenty hours.

FIG. 3. CASE VI. G. G.

March 31st. Three weeks after treatment her metabolic rate was 63.7505.

April 30th. Apex heart beat, 120. Systolic blood-pressure, 160; diastolic 80. Upper circumference of neck, 14½ inches; middle, 15½ inches; lower 15½ inches. Weight, 149½ lbs. Metabolic rate, 59.6556.

BASAL METABOLISM—April 30, 1921.

Time	*Reading*	*Barom.*	*Temp.*	*Height*	*Weight*
10:24	6575 cc.	29.31	20	5:07¾	154½
10:30	4150 cc.	29.31	20		
06 min.	2425 cc.	.913 Temp. Centigrade. 4.85 Calories per liter oxygen. 1.8 Body surface. (Du Bois Chart)			
1 hr.	24250 cc.				

CASE III. (February 16, 1921). K. R., male, aged seventeen, single. Occupation, farmer.

Complaint. Shortness of breath and nervousness.

Family History. Negative.

Personal History. Was well until thirteen years of age, when he complained of headaches and a cough. Had eyes examined and wore glasses without relief.

Was compelled to leave school when fifteen years of age. Had influenza which affected his heart so that it has been giving trouble ever since.

Last June had an appendiceal abscess which ruptured and was afterwards surgically drained. Made a good recovery but has an abdominal hernia. The rest in bed at the hospital improved his nervous condition.

PHYSICAL EXAMINATION

Eyes prominent, right eye more than the left. Thyroid area of the neck full and bulging. Tonsils not enlarged but red, and have many crypts.

Chest. Precordial pulsation. Apex beat slightly toward the left. Second heart sound accentuated but no murmur detected. Radial beat, 96; apex beat, 112.

Fine tremor of fingers on extension with longitudinal striae of nails. Systolic blood-pressure, 148; diastolic, 90. Weight, 150 lbs.

BASAL METABOLISM— February 17, 1921.

Time	*Reading*	*Barom.*	*Temp.*	*Height*	*Weight*
10:15	6000 cc.	29.34	20	5:08¼	150
10:21	2400 cc.	29.34	20		
06 min.	3600 cc.	.913 Temp. Centigrade. 4.85 Calories per liter oxygen. 1.9 Body surface. (Du Bois Chart)			
1 hr.	36000 cc.				

Metabolic rate, 83.8998. Upper circumference of neck, 15¼ inches; middle, 15½ inches; lower 16 inches.

Diagnosis. Exopthalmic hyperthyroidism clinically caused by influenza infection and subsequently rekindled by pus from an appendicular abscess.

Treatment. Was given 220 mgm. of radium in six tubes, each tube screened in 1 mm. brass and 1mm. gum rubber, all laid on a gauze pad 2 cm. in thickness and held over right lobe of thyroid for ten hours, then over the left lobe for eight hours.

March 28th (forty days following the treatment). Metabolic rate, 77.2382.

BASAL METABOLISM—March 26, 1921.

Time	*Reading*	*Barom.*	*Temp.*	*Height*	*Weight*
3:58	6000 cc.	29.71	22	5:08½	143
4:04	2800 cc.	29.71	22		
06 min.	3200 cc.	.919 Temp. Centigrade. 4.85 Calories per liter oxygen. 1.8 Body surface. (Du Bois Chart)			
1 hr.	32000 cc.				

May 20th. His eyes are normal in appearance. Complains of no cardiac pain or distress on exertion. Has no sweating, and in fact his thyroid symptoms are negative.

Pulse rate, 82. Systolic blood-pressure, 126; diastolic 86. Weight, 143 lbs. Metabolic rate, 44.1350. Upper circumference of neck 14¾ inches; middle, 14¾ inches; lower, 15 inches.

BASAL METABOLISM—May 21, 1921.

Time	*Reading*	*Barom.*	*Temp.*	*Height*	*Weight*
10:18	6400 cc.	29.54	23	5:08½	142
10:24	4600 cc.	29.54	23		
06 min.	1800 cc.	.910 Temp. Centigrade. 4.85 Calories per liter oxygen. 1.8 Body surface. (Du Bois Chart)			
1 hr.	18000 cc.				

CASE IV. (January 26, 1921). S. H., male, aged twenty-four. Ex-service. Occupation, bank clerk.

Complaint. Pain in left chest and nervousness.

Family History. Negative except that one sister was operated on for goiter.

Personal History. Always enjoyed good health. Smoked very little. Appetite good. Nervous and has pain in left side of chest on walking fast or on excitement. Perspires

freely on palms of hands and soles of feet.

Was in the service ten months. When discharged had a pulse of 120. Went home and was under the care of his family physician for three weeks. Later examined at the Marine Hospital and was sent to the Shurley Hospital for treatment. Remained in the hospital nine weeks. Had neck painted with iodine and had sixty-three violet ray treatments of left chest. Left the hospital feeling no better.

Had tonsilectomy done three months ago. Was referred to our service.

PHYSICAL EXAMINATION

Pulse 90 to 100. Systolic blood-pressure, 122; diastolic 78. Weight, 166 lbs. Metabolic rate, 53.2989.

BASAL METABOLISM—January 25, 1921.

Time	*Reading*	*Barom.*	*Temp.*	*Height*	*Weight*
10:18	7150 cc.	29.8	21	5:09¾	166½
10:24	4900 cc.	29.8	21		
06 min.	2250 cc.	.928 Temp. Centigrade. 4.85 Calories per hour. 1.9 Body surface. (Du Bois Chart)			
1 hr.	22500 cc.				

Upper circumference of neck 16½ inches; middle, 16¾ inches; lower, 17½ inches. Eyes are prominent with sclera showing around the cornea for ⅛ inch. Tongue tremulous.

Heart slightly dilated to the left with accentuation of second sound. A systolic murmur heard at apex which is referred toward axilla.

Neck prominent and enlarged over thyroid gland. The right lobe of thyroid is soft with a small cyst near the trachea. The left is enlarged but smaller than the right. The isthmus is also cystic.

The palms of the hands are wet with perspiration. The fingers tremulous on extension.

Diagnosis. Exophthalmic hyperthyroidism.

Treatment: Was given 180 mgm. in four tubes, each screened in 1 mm. brass and 1 mm. gum rubber. The tubes were laid on 2 cm. of gauze as a pad, and held over the right and left lobes of thyroid for ten hours each.

BASAL METABOLISM—February 25, 1921.

Time	*Reading*	*Barom.*	*Temp.*	*Height*	*Weight*
10:16	5200 cc.	29.21	17	5:09¾	167
10:21	2650 cc.	29.21	17		
05 min.	2550 cc.	.922 Temp. Centigrade. 4.85 Calories per liter oxygen. 2.0 Body surface. (Du Bois Chart)			
1 hr.	30600 cc.				

Four weeks after the treatment of February 25th, his metabolic rate was 68.4170, an increase of fifteen calories, which goes to prove that from the third to the fifth week after the treatment there is an increase in metabolism. Yet he was able to return to his bank position two weeks after the treatment.

April 8th. He feels perfectly well. Has none of his former symptoms. The eyes are less prominent and the neck measurements have decreased from 1 to 1½ inches. Caloric value found 39.4908.

BASAL METABOLISM—April 8, 1921.

Time	*Reading*	*Barom.*	*Temp.*	*Height*	*Weight*
10:06	6200 cc.	29.12	20	5:09¾	167½
10:12	4450 cc.	29.12	20		
06 min.	1750 cc.	.907 Temp. Centigrade. 4.85 Calories per liter oxygen. 2.0 Body surface. (Du Bois Chart)			
1 hr.	17500 cc.				

May 14th. Caloric value found 31.585. Metabolic rate 31.38 today, which is only ten weeks since the treatment.

BASAL METABOLISM—May 14, 1921.

Time	*Reading*	*Barom.*	*Temp.*	*Height*	*Weight*
10:04	5500 cc.	29.3	19	5:09¾	166½
10:10	4150 cc.	29.3	19		
06 min.	1350 cc.	.910 Temp Centigrade. 4.85 Calories per liter oxygen. 1:9 Body surface (Du Bois Chart)			
1 hr.	13500 cc.				

CASE V. N. L., female, January 24th, 1921. Aged thirty-nine, married. Occupation, housewife.

Complaint. Nausea, vomiting and weakness; duration, four years.

Family History. Negative.

Personal History. As a child enjoyed good health. Menstruated at fourteen years. Has always been regular. Is the mother of two children, one nineteen and the other fifteen years of age. Had four miscarriages. Menopause at thirty-five.

Has had diarrhea off and on for the past eleven years. Used to faint and have dizzy spells and lose her voice at times. Troubled

with headaches; is disinclined to work; perspires freely; is extremely nervous, cries easily and wants to be alone.

Two years ago had a partial lobectomy performed. Has lost over twenty pounds in weight since last November. All her symptoms have greatly increased until now she is a nervous and physical wreck.

PHYSICAL EXAMINATION

Radial pulse, 130. Apex beat, 150. Systolic blood-pressure, 150; diastolic, 90. Upper circumference of neck 13¼ inches; middle, 14 inches; lower, 15½ inches. Weight, 118 lbs. Metabolic rate, 167.6887.

BASAL METABOLISM—January 24, 1921.

Time	*Reading*	*Barom.*	*Temp.*	*Height*	*Weight*
10:45	7000 cc.	29.13	15	5:07½	120
10:50	2000 cc.	29.13	15		
5 min.	5000 cc.	.922 Temp. Centigrade. 4.85 Calories per liter oxygen. 1.6 body surface. (Du Bois Chart)			
1 hr.	60000 cc.				

She has a frightened anxious expression with both eyes bulging. The right worse than the left. Skin blotchy and muddy looking, with many pimples on face and shoulders which may be due to bromides. Tongue tremulous, both thyroid lobes enlarged and cystic.

Chest. Pulsation with every heart beat; atrophy of intercostal muscles.

Heart enlarged in all directions. A distinct systolic murmur heard at apex which is referred toward the axilla and upward to the left second intercostal articulation; murmur of a rough grating type that would suggest myocardial as well as endocardial change.

There is extreme muscular atrophy of arms and limbs. Fingernails brittle and with longitudinal striae. Fingers, hands and arms in extreme tremor on extension. Has edema of both ankles. Can only walk a few steps at a time. Been confined to bed for some weeks.

Diagnosis. Exophthalmic hyperactivity of an old thyroid adenoma.. Much degeneration of all important organs and glands.

Prognosis. Lessen toxicity and activity, and make her more comfortable.

Treatment. Was given 180 mgm. radium in six tubes, each screened in with 1 mm. brass and 1 mm. gum rubber and made into a gauze pad 2 cm. in thickness which was held over the left lobe of thyroid for eight hours then over the right lobe for ten hours; total of eighteen hours.

May 19, 1921. Patient is able to be around and attend to all her housework. Has no nausea or vomiting, sleeps well, has a good appetite and gained 12 lbs. in weight.

All of the symptoms have decreased in severity even to the eye prominence.

Four months ago she was confined to the bed while today she walked into the office.

Radial pulse and heart beat, 120. Systolic blood-pressure, 80. Upper circumference of neck 12¾ inches; middle, 13½ inches; lower, 14½ inches. Weight, 130½ lbs. Metabolic rate, 87.8069.

BASAL METABOLISM—May 20th., 1921.

Time	*Reading*	*Barom.*	*Temp.*	*Height*	*Weight*
10:20	7600 cc.	29.54	21	5:07½	130½
10:15	4800 cc.	29.54	21		
05 min.	2800 cc.	.916 Temp. Centigrade. 4.85 Calories per liter oxygen. 1.7 Body surface. (Du Bois Chart)			
1 hr.	33600 cc.				

CONCLUSIONS

1. The systolic blood-pressure is lowered in those cases with a high blood-pressure where the degeneration of the heart and kidneys has not become permanent.

2. The blood-pressure is raised in those where compensation is reestablished.

3. In those cases with a metabolic rate around 80 it was lowered for the first two weeks; raised for the third and fourth weeks, and then gradually decreased for the next few months.

4. In those with a metabolic rate above 100 with broken compensation it gradually decreased after the third week.

5. The metabolic rate was found to be normal in many very active cases three months after treatment.

6. Metabolism being the standard of toxic activity, the rate measurement will verify clinical findings, prove results of treatment, and show a physiological indication for future measures.

DISCUSSION

Dr. W. H. B. AIKENS. Dr. R. E. Loucks, in his paper and demonstration, has given us a valuable contribution to the advance made in

treating hyperthyroidism with radium, and one cannot speak too highly of the value of radium in toxic goiter.

I agree thoroughly with the reader of the paper that hyperthyroidism and toxic adenomata should no longer be regarded and classed as a surgical diseases, as the nervous and heart symptoms are in no way conducive to successful operation. Radium treatment is not accompanied by the risks and horrors of operation. But if, for cosmetic reasons, following the disappearance of the toxic symptoms, an operation is insisted upon by the patient, the fact that the radium has been used does not materially increase the surgical removal, though a good deal of fibrosis may have occurred and some firm adhesions may have been formed.

It may be interesting to note that eight years ago I read a paper in Toronto on this subject and Dr. Loucks was good enough to come over and hear it. It was suggested that it might be well to have the men meet who were taking a deep interest in radium therapy. The first constructive meeting was held in Detroit, when it was decided to form a radium society. A committee was appointed to frame a constitution, which later in the year, was adopted at a meeting in Philadelphia. I would not say that the subject of hyperthyroidism was the incentive to the formation of the American Radium Society but it certainly helped to bring it about.

As to the dose administered, I believe in moderation, and am glad to learn through correspondence with Dr. Pfahler that he views the smaller doses as being efficient. I know of one case where about 4,000 milligram-hours were administered, the result being apparently an entire obliteration of the thyroid gland with unfortunate after-results, as myxedema supervened and thyroid tablets are now being used.

Dr. George E. Pfahler. I have read Dr. Aiken's article and have had considerable correspondence with him and think I can agree with the things he says and the things that Dr. Loucks has referred to. I have had more experience in the treatment of these cases with *x*-rays, and as a rule I treat the patients who are able to come to my office with *x*-rays because I can get through with them and get them out and I have had excellent results. The patients who are bedfast and must stay in the hospital can afford to be treated there with radium, with equally good results—sometimes superior. In one case I was unable to influence the growth with *x*-rays, but got an excellent result from radium.

I would like to emphasize the importance of getting rid of focal infection in the teeth, tonsils, sinuses, and even in the gall-bladder and appendix. In one patient in whom I was not getting any response from radium we searched everywhere for focal infection and finally she had a definite group of symptoms pointing to the appendix. She then gave us a history that she had not given previously. You must all realize how often patients do not give us all the history. This patient then told me about the symptoms which pointed to involvement of the appendix for at least six years. The appendix was operated upon, a pus tube found, and she then began to improve. I have had some cases in which I got no result until I had abscesssed teeth removed. Now I make it a rule to examine the teeth of every patient who comes to the office for treatment, and if they do not have the teeth removed as I recommend they drag along and not much is accomplished until they do this.

I have used radium needles as surface applications rather than the larger capsules because I can get a wider and more even distribution over the tumor tissue. It is a mere matter of determining how much to use. I have been using 10 mgm. each, filtered through the thickness of the needle plus a millimeter of brass, and placed about 1 cm. apart at a distance of 2 cm. through cotton, and I have used them for from eight to sixteen hours. I noticed in Dr. Aiken's article he prefers to use smaller amounts of radium and longer periods.

I was rather surprised to hear Dr. Loucks say he used 200 mgm. on one side and then on the other. I have seen bad results from too much radium at the first application and would be afraid to use it in that quantity.

Dr. John Lincoln Bower. I just wish to cite a little experiment carried out in the thyroid of the dog. A needle was inserted and the gland was removed at the end of two weeks and showed practically no results except possibly the atrophy of the nucleus, which we observed in the metastatic glands. This was increased, and the glands removed at the end of two weeks showed a beginning fibrosis.

Dr Albert Soiland. It is a pleasure to listen to such a paper as that of Dr. Loucks, and when we can get the ocular evidence he shows, I think it is distinctly worth while. I had the pleasure of presenting a paper on a similar series before the Radiological Society of North America last year, and my results were much like his. We have to be careful in treating adenomata; the surgeons will get

after us if we try to treat these, but the metabolism test is doing much for us in determining when our agents are demanded. We are now treating a series of cases, which are being subjected to monthly metabolic tests. We are going to keep an accurate record and hope to present a tabulation of these cases at the next meeting.

Dr. R. E. Loucks. (closing the discussion). I only wish to comment on the point regarding focal infection. I think I emphasized the importance of removing any focal infection. One of the case reports I did not read was interesting. A man had a severe infection which left him with a bad heart. He had to leave school and later developed an appendiceal abscess which ruptured and had to be drained surgically. At that time his thyroid gland was badly affected and he was treated. He had a metabolic rate of 80, but after one radium treatment it was only 38. We know that focal infection is the thing to get after.

As to the dosage given, I think it is as nearly correct as it is possible to get it. I thought from 100 to 200 mgm. for eighteen or twenty hours was about right. Do not use the same amount of hours because I or anybody else said so, but use your judgment. Increase your alkalinity as you go along, by giving sodium bicarbonate and more sugar. The blood chemistry and urinalysis we learned were of small significance in the hyperthyroidism, unless you have a decompensated heart, with a kidney involvement.

I think a man who has had experience will not over-dose his cases as Dr. Aikens spoke of. You have to use judgment. We know that a blonde individual will not stand as much radiation as a brunette. If you get a radial pulse of 80 and an apex beat of 180, that tells you something. When you get a heart muscle of that kind you must not overload those people.

AMERICAN LITERATURE ON RADIUM AND RADIUM THERAPY PRIOR TO 1906*

By CARROLL CHASE, M.D.

BROOKLYN, NEW YORK

VERY soon after the discovery of radium by Professor and Madame Curie in 1898, certain of the medical profession became interested in the therapeutic possibilities of this newly discovered element and source of energy. This research was naturally promptly reflected in the medical and other scientific journals of the day.

It is the purpose of the writer in this article to review only the early American radium literature, the date at which it ceased to be really "early" having been arbitrarily fixed as January 1, 1906. The attempt will be made to give, first, a list of the books dealing entirely or in part with the subject named and adding a very brief review on each of them; second, an alphabetical list of all the articles that it has been possible to locate with comment on certain of the more interesting or important ones; third, a list of certain editorials appearing in medical journals, though this is farther from being complete than the first and second parts. It is sure that these lists are not complete although all the sources at the command of the writer have been searched. Corrections and additions will be much appreciated as it is my hope ultimately to compile as nearly complete a bibliography of the subject as is possible in both English and French. I believe that this article covers a field a little different than has hitherto been attempted. Although it is only a little over twenty years since radium began to be employed in medicine, the literature is already surprisingly extensive.

Because of the very remarkable physical properties of radium, and the fact that its discovery compelled the revision of previously existing notions regarding the composition of matter, the structure of the molecule and atom and the relation of electricity to matter, it is not surprising to find that physicists and physicians worked hand in hand in treating the earliest cases. Among the American physicists most worthy of mention are Dr. William Rollins of Boston, probably the first American to suggest radium as a therapeutic agent, William J. Hammer of New York, Professor Charles Baskerville, now of the College of the City of New York, Dr. George F. Kunz of New York, Professor P. G. Pegram of Columbia University and Professor John Trowbridge of Yale University. This list could be extended, but perhaps includes the American physicists most interested in the therapeutic possibilities of radium. While speaking of physicists it might be added that some of their very early prophecies have turned out to be most accurate. Further mention will be made of this in discussing some of their articles. At the same time a letter written by Alexander Graham Bell, inventor of the telephone, published in *American Medicine*, Philadelphia, August 15, 1903, p. 261, seems worthy of reproduction in full. It is as follows:

THE USES OF RADIUM

To the Editor of American Medicine:

It has occurred to me that perhaps you would care to publish the enclosed letter, and thus start some one experimenting with the radium rays in the manner suggested.

(Signed) Z. T. SOWERS.

Dear Dr. Sowers:

I understand from you that the roentgen rays and the rays emitted by radium have been found to have a marked curative effect upon external cancers, but that the effects upon deep seated cancers have not thus far proved satisfactory.

It has occurred to me that one reason for the unsatisfactory nature of these latter experiments arises from the fact that the rays have been applied externally, thus having to pass through healthy tissues of various depths in order to reach the cancerous matter.

The Crookes' tube, from which the roentgen rays are emitted is, of course, too bulky to be admitted into the middle of a massive

*Read at the Sixth Annual Meeting of THE AMERICAN RADIUM SOCIETY, Boston, June 6-7, 1921.

cancer, but there is no reason why a tiny fragment of radium sealed up in a fine glass tube should not be inserted into the very heart of a cancer, thus acting directly upon the diseased material. Would it not be worth while making experiments along this line?

(Signed) ALEXANDER GRAHAM BELL.

(REPLY)

Dear Mr. Bell:

The suggestion which you make in regard to the application of the radium rays to the substance of deep-seated cancer I regard as very valuable. If such experiments should be made I have no doubt they would prove successful in many cases in which we now have failures.

(Signed) Z. T. SOWERS, M.D.

The study of the early literature has some value other than its purely historical interest, as it gives the student a certain perspective that is difficult to obtain otherwise. It is needless to say that the gradual development of the present methods of technique is intensely interesting. In looking backward it may be seen that the early therapists developed a technique which is not so different from that of today, in a remarkably short space of time, even though the modern use of the emanation was not known.

It is rather strange in going over the list of early writers to find the names of but three men who are now members of the American Radium Society,—Dr. Robert Abbe, Dr. H. N. McCoy and Dr. Rollin H. Stevens,—although it is evident from the discussion of some of these early articles that certain other members were interested at this period, though they had themselves written nothing for publication.

It is interesting to note that several of the earliest references to radium in literature speak of the possibility of its use as an agent to take the place of the *x*-ray in the production of radiographs. Of course, this theory was soon dropped.

While it is a rather delicate subject to approach, I feel fairly sure that the following is a description of the first use of radium in this country as a therapeutic agent. It should be stated that what is here written is based almost entirely on what has been printed, backed by a certain amount of personal correspondence. Sometime during the year 1900 Dr. William Rollins of Boston, who had been previously much interested in the development of the *x*-ray, gave to Dr. Francis H. Williams, also of Boston, a small metal box with an aluminum front containing about 500 mgm. of a radium preparation of a strength of about 1000. Through the courtesy of Dr. Williams I am able to show you this identical package still intact. I think you will agree with me that it is of decided historical interest, as the use of this preparation by Dr. Williams was evidently the first employment of radium as a therapeutic agent in this country, and I feel that due credit should be given Dr. Rollins and Dr. Williams for their truly pioneer work. In fact, if positive proof of earlier work is not forthcoming, to these two men belongs the fame of being the earliest users in America.

Such proof as I have of this is as follows: The opening paragraph of a paper by Dr. Williams, which he states was written after consultation with Dr. Rollins, and was presented at the annual meeting of the Massachusetts Medical Society, June 9, 1908, says:

"In 1900 Dr. William Rollins of Boston suggested the use of the radiations from radium salts as a therapeutic agent and put capsules containing radium into my hands, but the salts then obtainable were not powerful enough to be efficient. But to Dr. Rollins is due the credit of being, so far as I am aware, the first to realize the probable value of these radiations as a therapeutic agent."

A personal communication from Dr. Williams in reference to this subject further states:

"I used this radium in rodent ulcer and lupus, but cannot give you a definite date as to my first use of it. It was too weak to compete with *x*-rays, although after some hours' application to the normal skin it caused a redness of the size of the capsule. In the summer of 1903 I went abroad and obtained 100 mgm. of pure radium bromide, and a large amount of radium of less radio-activity. On my return, I used the pure radium bromide with satisfactory results and started a radium clinic at the Boston City Hospital."

The following is a paragraph from an article entitled "Some of the Physical Properties and Medical Uses of Radium Salts; With Report of Forty-Two Cases Treated By Pure Radium Bromide", By Dr. Wil-

liams, which appeared in *The Medical News*, February 6, 1904:

"The first person, so far as I am aware, to appreciate that radium salts would probably be of service in the treatment of certain diseases was Dr. William Rollins, of Boston, who has done so much to promote the use of the *x*-rays. Between two and three years ago, Dr. Rollins put into my hands a metal box with an aluminum front, containing some chloride of radium, with the suggestion that I use it for therapeutic purposes. I did so employ it, but at that time the radium to be had was weak, and I did not obtain definite results."

It was undoubtedly true here, as has happened with other scientific discoveries that two or more investigators discovered the same fact or performed the same original experiment quite independent one of the others. The recognition of claims for early work is often made difficult by this fact.

The writer became interested in radium as a therapeutic agent in 1903 and treated his first case in November of that year, collaborating with his father, the late Dr. Walter B. Chase. It sounds rather strange at this time to state that the husband of the patient treated was willing to purchase the tube of radium salt that was used. The strength of this preparation was stated to be 7,000 (7,000 times the radio-active strength of uranium—the old method of measurement). This tube was purchased from the patient in January 1904 and a further supply of varying strengths was also obtained. One of these tubes when tested by modern methods in 1914 was found to contain but 50 micrograms, that is to say, .05 mgm. of radium element. In spite of the weakness of these preparations it is now possible to look back and note that certain results were obtained.

Strange as it may seem, radium literature is not without its humor, though it is usually the unconscious rather than the conscious form. In proof of this I am going to take the liberty of quoting literally two or three paragraphs of an article written in 1904.

"Radium is worth three times its weight in gold ($2,700,000 a pound).

"I believe that radium represents in its atoms the primordial elements of matter which God first charged with light, when He said, 'Let there be light.' In the aggregating of these elements to form the earth, radium was condensed from the rarified ultra-gouous state into solid masses, and with an immense amount of latent heat was packed away deep down in the mines of the earth. So soon as brought to the surface, and the pressure on its atoms lessened, the latter begin to disintegrate, and the internal heat is liberated. The particles at and near the surface rapidly fly off in every direction until the underlying more compact part is reached, the particles of which in their turn become gradually detached, and fly off in rapidly increasing quantities. Thus the atoms in one zone after another undergo disintegration with the liberation of energy.

"God *created* the primordial elements of matter before he *made* atoms, and molecules, and suns, and moons, and stars; and God created the primordial energy of motion before he made light, and heat, and electrictiy, and the other energies.

"In conclusion, I offer two theories explanatory of the action of radium:

"The first is that radium breaks up into infinitesimal particles, which are projected through the masses of other matter and divide them into fragments so minute that they readily pass through the walls of capillaries into the blood current, and are carried to the emunctories to be excreted. This is the mechanical theory. The second is that the cutting to pieces of the diseased masses by radium rays sets up an irritation to the tissues, causing afflux of blood and aggregation of leucocytes. The leucocytes pick up and carry off the divided masses. This is the vital theory.

"Radium shoots its myriads of fiery missiles through tumors, indurations, plastic deposits, etc., cuts them to pieces and renders them absorbable. It also shoots to death bacteria and protozoa by riddling them with its fast-flying projectiles and shattering them into a thousand fragments.

"This self-loaded and self-discharging engine of destruction keeps up its continuous but noiseless work with no appreciable evidence of exhaustion. Another remarkable fact is that the little projectiles sent out from radium, wherever they lodge, explode and scatter their fragments in all directions, dealing death and destruction to microbes."

However, despite an occasional lapse

such as this, the general average of the articles from the scientific standpoint is really very good. Following are the three lists comprising ten books, one hundred and twelve original articles and seventeen editorials.

BOOKS ON OR HAVING CHAPTERS ON RADIUM OR RADIUM THERAPY PRIOR TO 1906—AMERICAN

ALLEN, CHARLES WARRENNE, M.D., with the cooperation of Milton Franklin, M.D. and Samuel Stern, M.D. Radiotherapy and Phototherapy, Including Radium and High-Frequency Currents, Their Medical and Surgical Applications in Diagnosis and Treatment. Philadelphia, 1904.

This work on the subjects named includes a chapter of 31 pages entitled "Radio-Activity" in which radium and the other radio-active elements are discussed in a fairly comprehensive manner; although the writer says nothing of any personal work along this line.

BASKERVILLE, CHARLES, Ph. D., Radium and Radio-Active Substances; Their Application Especially to Medicine. Philadelphia, 1905.

This is a very concise treatise on the physics of radium, while one chapter, 27 pages, treats of "The physiological action of radio-active substances and their therapeutic applications." This gives an excellent summary of radium therapy up to 1905 and the accompanying bibliography is very good.

BECK, CARL, M.D. Roentgen Ray Diagnosis and Therapy. New York, 1904.

This book has a chapter of five pages entitled "Becquerel Rays and Radium," in which the subject is discussed very briefly.

CLEAVES, MARGARET A., M.D. Light Energy, its Physics, Physiological Action, and Therapeutic Applications. New York, 1904.

One chapter, 57 pages, is devoted to what was at that time a comparatively complete treatment of the subject of radium and radium therapy. It includes a fair bibliography of the subject.

COHEN, SOLOMON SOLIS, M.D. (Editor) System of Physiologic Therapeutics. Volume XI; Serotherapy, Organotherapy, Bloodletting, Radium, etc. Philadelphia, 1905.

This volume contains an article by Samuel G. Tracy, B.S. M.D., entitled "Radium, Thorium, and Radioactivity", which covers 33 pages and includes illustrations. The physics and the therapy of radium and the allied elements are very well discussed condidering the knowledge then available.

FREUND, LEOPOLD, M.D., Elements of General Radiotherapy for Practicioners, Translated by G. H. Lancashire, New York, 1904.

This is an English translation of a work published in Vienna, this English translation being printed in New York. It is a textbook on radiotherapy in general. One chapter, 15 pages, entitled "Becquerel-Rays," deals with the physics and therapeutics of radium.

HAMMER, WILLIAM J. Radium and other Radio-Active Substances; Polonium, Actinium, and Thorium, with a Consideration of Phosphorescent and Fluorescent Substances, the Properties and Applications of Selenium and the Treatment of Disease by the Ultra-Violet Light. New York, 1903.

A lecture delivered at a meeting of the American Institute of Electrical Engineers and the American Electrochemical Society, New York, April 17, 1903. The section of the book on radium takes up 31 pages, and deals almost entirely with its physics.

HAMPSOM, W., M.A. Radium Explained. A Popular Account of the Relations of Radium to the Material World, to Scientific Thought and to Human Life. New York, 1905.

This is an English work printed in Edinburgh, but bearing an American imprint. It is a popular account of the physics of radium and includes one chapter of 7 pages on "Radium and the Cure of Disease".

HIRSHBERG, LEONARD K., M.D. The Action of Light as a Therapeutic Agent. Providence, 1904. The Fiske Fund Dissertation XLVII.

This is a pamphlet, in which radium is discussed incidentally, the remarks on it covering 7 pages. It includes a very fair bibliography.

KING, WILLIAM HARVEY, M.D., LL.D. Static, High Frequency,Radio, Photo and Radium Therapy. New York, 1905.

This is a general treatise on the subjects stated. One chapter of 6 pages deals with the physics of radium and its emanation, while another chapter of 9 pages deals with the physiological action and therapeutics of radium.

LARKIN, EDGAR L. Radiant Energy, Los Angeles, Cal. 1903.

This is a rather popular work dealing with radiant energy—"radiant" here meaning, so the author states, "proceeding from a center in straight lines in every direction". The mention of radium and other radio-active elements is almost incidental.

ROLLINS, WILLIAM. Notes on *X*-Light. (Privately printed). Boston, Mass., 1904.

A beautiful volume, being a reprint of the various articles by the author appearing in many magazines, during 1896 to 1904, including four, dealing more or less directly with radium. Two of these articles are quite remarkable. One of them, "Radio-Active Substances in Therapeutics" (*Bost. M. & S. J.*, January 23, 1902), is perhaps the first American article dealing with radium as a therapeutic agent. It is short and of sufficient interest to quote in its entirety.

"During the year 1900 I made experiments with radio-active substances hoping to find a substitute for *x*-light. I found that some of the radiations retained their activity after passing through animal tissues as thick as the body of a guinea pig. I was so convinced of the value of radium that I placed about 500 mgm. in a sealed capsule to protect it from moisture, giving it to a physician with the request that it be tried on lupus, a disease which at that time was interesting him. The capsule was disk-shaped, with a front of aluminum, a back of comparatively nonradiable metal. I believe it to be important to test these substances in the treatment of lupus, superficial cancer, and diseases of the skin in which *x*-light has been found useful; therefore, I mention that I have another capsule which I shall be glad to send to any Boston physician who will give the matter a fair trial. Radio-active substances can be used in sealed capsules held against the body by adhesive plaster, or they can be made to cover larger areas by mixing them with rubber or celluloid to form moisture-proof plasters. These plasters may be still further protected by being coated on the sides nearest the body by aluminum foil and on the opposite sides by lead foil. They could be kept in stock by the yard by druggists and given to patients by prescription, with proper directions as to the length of application. They could be worn at night. Their use would prevent the poor from making such frequent visits to a physician as are now required when *x*-light obtained from a vacuum tube is used. This is a matter of some importance, as the present treatment takes many sittings which require time and cost money."

*Note added 1904: "Considering the present interest in radium, it may be worth while to say that no application was received for this capsule."

The other article entitled, "Some Principles Involved in the Therapeutic Applications of Radio-Activity" (*Bost. M. & S. J.*, November 12, 1903) states clearly certain principles, the value of which is only beginning to be appreciated today. The use of radium emanation in place of radium element is forecasted, and the question of applications made at a distance from the affected part is clearly discussed. He says, "In using the radio-active substances in disease of or near the skin, the depth of the diseased tissue to be affected must determine the distance of the radio-active substance from the surface of the patient, for the reason mentioned, namely, activity diminishes approximately as the square of the distance, though really more rapidly on account of the complex nature of the activity. If the radium is

placed ten centimeters from the skin, the intensity at a depth of one centimeter is nearly as great as at the surface for the more penetrating forms of activity. In many cases, therefore, the sound tissues below the diseased will be acted upon by a destructive agent whose activity would be nearly as great as at the place of disease.* The correct way in treating a skin disease with a radio-active substance is to consider to what depth it is desirable to confine as far as possible the activity. If to a slight depth, the radio-active substances should be almost in contact with the skin, the duration of the application being of proper length but always shorter than when at a greater distance. In this case healthy tissue at a depth of one centimeter would be acted on by radiations and emanation whose intensity would be less than one one-hundredth of those striking the skin; obviously a more scientific method."

This article further mentions what seem to be the earliest therapeutic experiments in this country—the treatment of lupus, and superficial cancers, with capsules of radium of a strength of 1000 (1000 times the strength of uranium) given to Dr. Francis H. Williams in the year 1900 and 1901.

ORIGINAL ARTICLES ON RADIUM AND RADIUM THERAPY PRIOR TO 1906—AMERICAN

ABBE, ROBERT, M.D. Radium and Radio-Activity. (*Yale M. J.*, June, 1904, Page 433.) The Subtle Power of Radium. (*Tr. Am. Surg. Ass.*, xxii, 253-262, also *Med. Rec.*, Aug. 27, 1904, 321-324).

Two excellent articles, illustrated, giving a number of careful case reports. In the second of these articles he states "It gives me pleasure to put on record such observations as I have been able to make during fifteen months with the best radium made by the laboratory of the Curies in Paris. I was able, by cabling a very early order, to get fifteen centigrams (2¼ grains) of the strength 300,000, which was part of the larger amount used by them in their experiments for calorimetric determinations (now historic). With this and other strong specimens obtained later, including one of German manufacture, denominated a million activity, I have been able to verify most of the interesting work of the foreign observers and to add some of my own." This proves that Dr. Abbe was one of the earliest original investigators in this country. Dr. W. W. Keen of Philadelphia discussed this paper and stated that he himself had treated 22 cases with radium.

*The alpha and beta rays having been filtered out.

ABBE, TRUMAN, A.B., M.D. Notes on the Physiologic and the Therapeutic Action of Radium. (*Wash. Med. Ann.*, January, 1904, p. 363-367).

A very good article including the report of a case of inoperable carcinoma of the cervix and vagina treated with radium, and also a very good bibliography.

ALLAN, S. J. Excited Radio-Activity Produced from Atmospheric Air. (*Proc. & Trans. Roy. Soc.*, Canada, Trans., 1902, ii, 71).

BALL, M. V., M.D., Radium; Its Possibilities in Medicine. (*Med. Fortnightly*, March 10, 1904, p. 149-151).

BARKER, G. F. Radio-activity and Chemistry. (*The Apoth. N. Eng. Drug.*, 1903, xv, 475-554-622).

BASKERVILLE, CHAS., Ph.D. Radium and Its Physiological Actions. (*Virginia M. Semi-month.* October 7, 1904, 298-299).

A brief article based on the chapter of his book dealing with the physiological action and therapeutics of radio-active substances.

BECK, JOSEPH C., M.D., Experiments with Radium in Some Nose, Throat and Ear Diseases. (*Laryngoscope*, December, 1904, 897-915, also *Chicago M. Rec.*, December 15, 1904, pp. 757-775).

A very good article with eleven extensive case reports and minor comment on other cases.

BECQUEREL, HENRI, D.C.L., Ph.D. On the Radio-activity of Matter. (*Rep. Smithson. Inst.*, 1902, p.197. Reprinted after revision from the *Scient. Am. Sup.*, June 7, 1902, No. 1379).

Bolton, H. C. An Experimental Study of Radio-Active Substances. (*Rep. Smithson. Inst.*, 1898-9, pp. 155-162). A New Source of Heat; Radium. (*Pop. Sc. Month.* 1903, lxiii, 61-63).

Boltwood, B. B. On the Radio-Activity of Natural Waters. (*Am. J. Sc.* 1904, xviii, 378). On the Ultimate Disintegration Products of the Radio-Active Elements. (*Am. J. Sc.*, 1905, xx, 253-267).

Bradbury, R. H. Radium and Radio-Activity in General. (*Frankl. Inst.*, 1905, clix, 225-238).

Brokaw, A. V. L., M.D., Presentation of Specimen of Radium With Suggestions As to Its Therapeutic Value in Cancer and Other Malignant Diseases. (*St. Louis M. Rev.* December 12, 1903, pp.415-417).

Bumpstead, H. A. Atmospheric Radio-Activity. (*Am. J. Sc.*, 1904, xviii, 1-11).

Bumpstead, H. A. & Wheeler, L. P., Note On Radio-Active Gas in Surface Water, (*Am. J. Sc.*, 1903, xvi, 328). On the Properties of Radio-Active Gas Found in the Soil and Water Near New Haven (*Am. J. Sc.* 1904, xvii, 97-111.)

Camp, E. T., M.D. Electric and Radiant Energy as Therapeutic Agents, (*Alabama M. J.*, June, 1905, pp. 356-369).

Cleaves, Margaret, M.D. Radium With a Preliminary Note on Radium Rays in the Treatment of Cancer, (*Med. Rec.* October 17, 1903, 601-606, also *J. Advanc. Therap.*, November, 1903, pp. 667-682).

The article of October 17th is, seemingly, the first which gives an actual report of a case treated with radium; that is to say, while other physicians undoubtedly treated cases at a much earlier date than this one (September 15, 1903), the history of this case was the first one published in America. This was a sarcoma of the left cheek. The same day a case of carcoma of the cervix was treated.

Curie, P. Radium. (*Rep. Smithson. Inst.*, 1902-3, pp. 187-201).

Dadourian, H. M. Radio-Activity of Underground Air. (*Am. J. Sc.*, 1905, xix, 16-22).

Dearborn, Frederick M., M.D. Radium Therapy in Skin Diseases (*N. Am. J. Homeop.*, November, 1905, 717-20).

Dennet, D. C., M.D. Radio-Therapy With Report of Cases. (*Med. Rec.*, February 13, 1904, 253-256).

Dieffenbach, William H., M.D., A New Method For the Therapeutic Application of Radium Salt (*N. Am. J. Homeop.*, December, 1905, 769-774).

Drake, G. W., M.D. Radium Rays and Their Therapeutic Possibilities. (*Charlotte N.C. M. J.*, 1904, xxiv, 168-171).

Duncan, R. K., The Electric Theory of the Radio-Activity of Matter, etc. (*New Knowledge*, 1905, also *New York Herald*, August 6, 1905).

Einhorn, Max., M.D. Radium Receptacles For The Stomach, Esophagus, and Rectum, (*Med. Rec.*, March 5, 1904, p. 399).

A brief article illustrating and describing the author's radium capsule, which was attattached to a thread and swallowed by the patient having cancer of the stomach. A bougie to which a radium capsule is screwed is also described for use in cases of cancer of the esophagus and rectum. The capsule contained 250 mgm. of 7,000 activity radium. Bougies of a similar style are used today for esophagus cases.

Observations on Radium. (*Med. Rec.*, July 30, 1904, pp. 164-168).

This article describes the author's method of the transillumination of various organs with radium. Among other things he was able to determine the position of the greater curvature of the stomach. Several cases of esophageal cancer treated by radium are reported.

FREUDENTHAL, W., M.D. The Effect of The Rays of Radium Upon The Mucous Membrane of The Larynx. (*Arch. Electrol. Radiol*, 1905, iv, 318-320).

A preliminary report of a case of laryngeal tuberculosis treated by radium.

GAGER, CHARLES STUART, Ph.D., Preliminary Note on the Effects of Radium Rays on Plants. (*Am. Med.*, ix, 1905, p. 1026).

Preliminary Notes on the Effects of Radio-Activity on Plants, (*Science*, 1905, n.s. xxii, 118).

GIES, WILLIAM J., Studies of the Effects of Radium with Demonstration. (*Proc. Soc. Exper. Biol. & Med.*, 1904-5, ii, 86).

HAMMER, WILLIAM J., Radium, Polonium and Actinium; (*Scient. Am. Sup.*, February 28, 1903, 22710-22711).

A very good popular account of the physics of radium and the allied radio-active elements.

HODGSON, FRED G., M.D., Radium; A Review of the literature. (*N. York. M. J.*, January 14, 1905, pp. 62-65).

An article that is satisfactory as far as it goes, but as it only gives some seventeen or eighteen references, is far from complete.

INGLIS, JOHN, A.M., M.D. Radium and Radiant Energy. (*J. Am. M. Assn.*, February 6, 1904, pp. 370-373).

KANOLT, C. W. Radium, Its Extraordinary Properties. (*Scient. Am.*, February 28, 1903, p. 149.)

A brief but concise article on the physics of radium.

KING, WILLIAM HARVEY, M.D., LL.D. Radium and Its Use in Medicine. (*N. Am. J. Homeop.*, December, 1903, pp. 729-733.)

One of the earliest articles. He reports a case of neuritis of the right optic nerve treated by him in 1903. He also speaks of the work of Mr. W. J. Hammer. The article ends with the following prophecy: "The professional world is alive to the great possibilities there are in radium, and I venture to predict that within a very few years it will occupy an important, yet limited, and unique position in therapeutics."

KROPATKIN, PRINCE., Unsuspected Radiations. (*Rep. Smithson. Inst.*, 1899-1900, pp. 371-385).

KUNZ, GEORGE F. Radium. (*American Review of Reviews*, November, 1903).

An excellent popular article on the subject.

KUNZ, GEORGE F., and BASKERVILLE, CHARLES. The Action of Radium, Roentgen-Rays and Ultra-Violet Light on Minerals and Gems. (*Science*, 1903, n. s. xviii, 769-783).

An important scientific article on the subject named.

LIEBER, HUGO, Radium und Radio-Aktive Stoffe und Deren Verwendung in der Medizin. (*N. Yorker Med. Monatschr.*, 1904, xvi, 49-58. Discussion 253-256). Radium and Some Methods for Its Therapeutic Application, With Demonstrations (*Proc. Soc. Exper. Biol. Med.*, 1904-5, ii, 32-37. Also *Med. News*, 1905, lxxxvi, 229-231, also *Am. Med.*, January 14, 1905, p. 72).

LLOYD, JOHN URI, Phar. M. Radiant Energy, (*Eclect. M. J.*, November, 1903, 583. Also *Cincin. Lancet-Clinic*, December 5, 1903, p. 595).

MCCOY, H. N. Radio-Activity as an Atomic Property. (*J. Am. Chem. Soc.*, 1905, xxvii, 391-403).

MCLENNAN, J. C., and BURTON, E. F. On the Radio-Activity of Metal Generally. (*Univ. Toronto, Stud. Phys. Sc.*, 1903, pp. 27-32).

MERZ, C. H. The Physics and Therapy of Radium. (*Electro-Therap.*, 1904, viii, 80-87).

METZENBAUM, MYRON, B.S., M.D. Radium, Radio-Active Substances and Aluminum with Experimental Research of the Same. (*Cleveland M. J.*, May, 1904, pp. 191-208).

A rather long article giving the details of a number of original experiments on the physics of radium and the allied elements and also reporting a case of lupus treated with radium.

Radium, Its Value in the Treatment of Lupus, Rodent Ulcer, and Epithelioma, With Reports of Cases. (*Internat. Clin.*, 1905, iv, 21-31. With 6 plates).

Radium; Its Value in Medicine. (*Cincin. Lancet-Clinic*, May 13, 1905, pp. 555-557. Also *Canad. Pract. & Rev.*, October, 1905, pp. 548-551. Also *Louisville Month. J. M. & S.*, November, 1904, pp.188-190).

This article includes the report of six cases of rodent ulcer, lupus and superficial epithelioma, all successfully treated with radium.

MEYER, G. M. The Radio-Activity of the Different Organs after the Intravenous Injection of Radium Bromid (Abstract). (*Am. Med.*, 1905, ix, 1030).

MILLIKAN, R. A. Recent Discoveries in Radiation and Their Significance. (*Pop. Sc. Month.*, April, 1904, pp. 481-499).

MOFFET, CLEVELAND. The Wonders of Radium. (*McClure's Mag.*, November, 1903, p. 1).
Sense and Nonsense About Radium (*Success*, April, 1904).

MORTON, WILLIAM JAMES, M.D. Treatment of Cancer by the *X*-Ray, with Remarks on the Use of Radium. (*Internat. J. Surg.*, October, 1903, pp. 289-294).

PARKHURST, BURLEIGH, M.D. Therapeutic Experiments with Radium. (*Pacific Coast J. Homeop.*, 1904, xii, 137-142).

Radium Therapy, Experiences and Suggestion. (*Tr. Am. Inst. Homeop.*, Chicago, 1905,lxi, 792-795. Also *N. A. J. Homeop.*, November, 1905, pp. 713-717).

PARTRIDGE, E. A., and BRADBURY, R. H. Radio-Activity, (*J. Frank. Inst.*, 1903, clvi, 1596-1599).

PEGRAM, G. B. Detection and Measurement of Radio-Activity. (*Arch. Electrol. & Radiol.*, 1904, iv, 313-317).

An excellent scientific article and one of the earliest dealing with the subject named.

PHILIPS, W. C. Experiences With Radium Emanations. (*Med. News*, 1905, lxxxxvii, 341-343).

PIFFARD, HENRY G., M.D., LL.D. Radio-Praxis. (*Med. Rec.* March 7, 1903, 361-366).
Radium, the First Wonderful Discovery of the New Century. Its Identity, Discovery, Properties, Effects upon Living Tissue, Probable Therapeutic Uses and Magnificent Possibilities. (*Med. Council*, December, 1903, pp. 405-408; January, 1904, pp. 1-4).

A very good popular article. It is unsigned but is attributed to Dr. Piffard by the index of the Surgeon General's Library.

A Few Words Concerning Radium. (*Med. Rec.*, June 18, 1904, pp. 999-1004).

A good article, which is, as he states, "an outline of the principal facts that have been ascertained concerning radium".

PRESCOTT, S. C. The Effect of Radium Rays on the Colon Bacillus, the Diphtheria Bacillus and Yeast. (*Science*, 1904, n. s., xx, 264).

PUSEY, WILLIAM ALLEN, A.M., M.D. Radium and its Therapeutic Possibilities. (*J. Am. M. Assn.*, July 16, 1904, pp.173-180, with discussion).

A well-written and conservative paper read before the fifty-fifth annual session of

the American Medical Association. It sums up very well the facts known at the time. The discussion is also interesting.

RAMSAY, SIR WILLIAM. Radium and Its Products. (*Harpers Monthly Mag.*, N. Y., 1904, cx, 52-57).

RAMSAY, SIR WILLIAM and SODDY, F. Experiments in Radio-Activity and the Production of Helium with Radium. (*Rep. Smithson. Inst.*, 1902-3, pp. 203-206).

ROBARTS, HEBER, M.D., M.E. Radium (*Am. J. Surg. & Gynec.*, March, 1904, pp. 145-148, and April, 1904, pp. 153-156).

Radium. (*Dental Brief*, 1904, ix, 409-418; Also *Med. Fortnightly*, May 10, 1904, pp. 279-284. With one illustration).

ROCKWELL, A. D., A.M., M.D. Radio-Activity. (*Arch. Physiol. Therapy*, March, 1905, i, 65-68).

ROLLINS, WILLIAM. The Cathode Stream and *X*-Light, (*Am. J. Sc.*, November, 1900, 383-391).
Notes on *X*-Light: Radio-Active Sub-Stances in Therapeutics (*Boston M. & S. J.*, January 23, 1902, 85).
Some Principles Involved in the Therapeutic Applications of Radio-Activity (*Boston M. & S. J.*, November 12, 1903, pp. 542-544).

On Passing The Beta Radium Rays Through a Strongly Charged Aluminum Plate. (*Elect. Rev.* January 9, 1904).

The second and third of these articles are reviewed at length in the part devoted to books. The first article mentioned, published in November, 1900, mentions experiments on human tissues, with radio-active substances and comments on the possibility of their being used in medicine.

RUDIS-JICINSKY, J., M.D., A.M., M.E. Experimental Investigations with Radium Upon Living Tissues. (*Iowa M. J.*, April 15, 1904, pp. 141-143).
Radium, a Name Only. (*Am. X-Ray J.*, April 15, 1904, pp. 102-104).
The Dosage in the Treatment With Radium. (*Iowa M. J.*, September 15, 1904, pp. 344-346).
Radium in Surgery. (*Arch. Physiol. Therapy*, March, 1905, pp. 74 to 77).

The first of these articles gives the results of certain experiments on guinea pigs and rabbits with the microscopical findings of the tissue exposed to radium.

The third article reports a case of mammary carcinoma treated with radium unsuccessfully. Only fifty mgm. of 7,000 activity were used.

RUTHERFORD, ERNEST, D. Sc., Ph.D., LL.D. F. R. S. The Existence of Bodies Smaller than Atoms. (*Proc. & Trans. Roy. Soc. Can.*, 1902, ii, 79).
Excited Radio-Activity and Ionization of Atmospheric Air. (*Bull. Am. Phys. Soc.*, 1902, ii, 59).
Radium. (*Montreal M. J.*, February, 1904, pp. 112-116).
Present Problems in Radio-Activity. (*Pop. Sc. Month.*, May, 1905, pp. 5-34).

The third of these articles, being an abstract of a lecture with experiments delivered before the Montreal Medico-Chirurgical Society, January 8, 1904, gives a very concise summary of the physics of radium and warns agains its careless use as a therapeutic agent.

SABINE, WALLACE C., A.M. The Physical Relationship of Finsen Light, Roentgen-Rays and Radio-Activity. (*Med. Communicat. Mass. M. Soc.*, 1904, xix, 645-655. Also *Boston M. & S. J.*, August 11, 1904, 159-161).

An excellent scientific article on the subject named.

SHIELDS, PERCY, M.D. *X*-Ray Phenomena and Phenomena Not Due to *X-Rays* (*Cincin. Lancet-Clinic*, April 11, 1903, pp. 371-377).

SHIELDS, EDWARD H., M.D. For What Conditions and How Should *X-R*ays Be Used? (*Cincin. Lancet-Clinic*, April 11, 1903, pp. 377-382.)

These two articles form practically one and mention radium incidentally.

SICKLES, WILLIAM, M.D. Radio-Activity. The Therapeutic Result We May Expect at its Present Stage of Development. (*Wisconsin M. J.*, April, 1905, pp. 623-627).

A good article dealing largely with the physics of radium and warning against so-called radium therapy with preparations having an activity of 200 or 300 and stating quite truly that no conclusions can be drawn from such treatments.

SOUTHWICK, GEORGE R., M.D. Radio-Activity. (*N. Eng. M. Gaz.*, November, 1904, pp. 496-505).

STAPLER, D. A. Radium. (*Occidental M. Times*, 1904, xviii, 49-52).

STEVENS, ROLLIN H., M.D. Clinical Experience With Radium. (*University Homeopathic Observer, Univ. of Mich.*, January, 1904).
Further Clinical Experiences with Radium with the Special Reference to Leiber's Radium Coatings. (*Trans. Am. Inst. Homeop.*, 1905, lxi, 796-800. Also *N. Am. J. Homeop.*, November, 1905, pp. 720-725).

These articles give Dr. Stevens' personal experiences with the use of radium and comment favorably on Leiber's radium coatings as a method of application.

STEWART, R. M. On Excited Radio-Activity. (*Proc. & Trans. Roy. Soc. Can.* 1902, p. 71).

STORCK, J. A. Some Facts Concerning Radium and the Use of the Intragastric Radiode. (*Am. Med.*, 1904, vii, 820-822. Abstr. *N. Orl. M. & S. J.* May, 1904, pp. 851-852).

STOVER, G. H., M.D. Radium. (*Colorado Med.*, January, 1904, pp. 92-97).

An article dealing with the physics of radium and mentioning some of the author's experiments as well as giving three case reports.

SULLIVAN, J. C., M.D. Radio-Activity. (*Illinois M. J.*, August, 1904, pp. 236-238).

TAYLOR, W. H. Radium, Its Radiations, Physical, Chemical & Mental. (*Old Dominion J. M. & S.*, Richmond, 1904-5, iii, 417-438).

THOMSON, J. J. On Bodies Smaller than Atoms. (*Pop. Sc. Month.*, 59, 1901, 323. *Ann. Rep. Smithson. Inst.*, 1901, p. 231, 1902).

TRACY, SAMUEL G., B.S., M.D. Radium in Medicine. (*N. York. M. J.*, October 24, 1903, pp. 792-794).
Radium. (*J. Advanc. Therap.*, December, 1903, pp. 758-767).
Radium: Induced Radio-Activity and its Therapeutical Possibilities. (*N. York M. J.*, January 9, 1904, pp. 49-52).
Thorium: A Radio-Active Substance with Therapeutical Possibilities (*Med. Rec.*, Jan. 23, 1904, pp. 126-128).
Radium. (*Med. Brief*, 1904, xxxii, 43-48).

Dr. Tracy was among the earliest experimenters and users of radium and the allied elements. His series of articles is of decided interest. Also note the review of the book, "System of Physiologic Therapeutics", Volume xi, edited by Cohen.

TROWBRIDGE, JOHN, S.D. Recent Advance in Physical Science. (*Internat. Month.*, January, 1900, pp. 123-132).

A very important early article on the *x*-rays and radio-active substances, etc., which mentions the possibility of the use of radio-activity as a therapeutic agent.

TROWBRIDGE, JOHN, S.D. and ROLLINS, WILLIAM. Radium and the Electron Theory. (*Am. Jour. Sci.*, 1904, n.s., xviii, 77-79).

VAN BUREN, F., Jr. and ZINSSER, H. Some Experiments with Radium on Bacteria. (*Am. Med.* 1903, vi, 1021).

This article is one of the earliest dealing with the action of radium on bacteria.

WALLIAN, SAMUEL S., A.M., M.D., Radio-Activity in Diabetes and Nephritis. (*St. Louis M. Rev.*, August 26, 1905, pp. 179-180).

This article mentions the fact that the therapeutic value of the water from certain famous springs is evidently due to its radio-activity.

WATTIEZ, Cy. Radium, its Recent Development. (*Scient. Am. Suppl.*, No. 1438, 1903).

WIGHT, J. S. Recent Researches in Radio-Activity and Electricity. (*Am. Med.*, March 5, 1904).

WILLIAMS, FRANCIS H., M.D. Note on the Use of the Fluorometer to Estimate the Proportions of Beta and Gamma Rays Given off from Radium Salts. (*Boston M. & S. J.*, December 17, 1903, p. 691).

Some of the Physical Properties and Medical Uses of Radium Salt, with a Report of Forty-Two Cases Treated by Pure Radium Bromide (*Med. News*, 1904, lxxxiv, 241-246).

A Comparison between the Medical Uses of the *X*-Rays and the Rays From the Salts of Radium (*Boston M. & S. J.*, February 25, 1904, pp. 206-209).

Notes on Radium. Production of the Gamma Rays from the Beta Rays of Radium; Use of Radium in Some Diseases of the Eye (*Boston M. & S. J.*, May 26, 1904, pp. 559-561).

Dr. Williams' work with radium as a therapeutic agent, seemingly the earliest in this country, has been commented on in the body of my article. The second and third of these four papers are particularly valuable from the scientific as well as the historical standpoint. The technique of the applications is especially interesting.

WINKLER, CLEMENS. Radio-Activity and Matter (*Pop. Sc. Month.*, 1905, p. 267).

EDITORIALS ON RADIUM AND RADIUM THERAPY PRIOR TO 1906—AMERICAN

The Future of the *X*-Rays. (*J. Am. M. Assn.*, January 13, 1900, p. 115).

Comment on Professor Trowbridge's article in the *International Monthly* for January, 1900. It mentions the possibility of radio-active substances being employed in place of *x*-rays to make radiographs. It states that there are other scientific possibilities and ends by saying, "no one can tell, nevertheless, what new possibilities may exist even in this particular direction, in the near future."

The Radium Rays in Therapeutics. (*J. Am. Assn.*, October 4, 1902, p. 846).

This mentions the work of some of the early French radium therapists—Danlos, Hallopeau and Gadaud.

Radium in the Treatment of Lupus. (*N. York M. J.*, April 25, 1903, p. 754).

Mentions the work of the same three French experimenters named above.

Remarkable Properties of Radium. (*J. Am. M. Assn.*, May 9, 1903, pp. 1293-1294).

Radium and Cancer. (*J. Am. M. Assn.*, July 11, 1903, pp. 107-108).

Mentions the report of a case treated by Professor Gusenbauer of Vienna.

Further Observations in Regard to Radium. (*J. Am. M. Assn.*, August 1, 1903, p. 317).

Mentions further experiments by French and Austrian scientists.

A Radium Calculation. (*J. Am. M. Assn.*, August 8, 1903, pp. 376-377).

Mentions an article in the English periodical "Nature", in which it is calculated that 3.6 grams in each cubic meter of the sun's bulk would be all that is required to account for the radiation. It also says, "An ounce, or

even a gram of radium might be an awkward thing to handle, and the isolation of a larger quantity be a positive danger to the community."

Radium. (*Med. Rev. of Rev.*, August 25, 1903, pp. 730-731).

Considers the physics of radium and mentions the possibility of its use ultimately in medicine.

Radium as a Therapeutic Agent. (*Med. Rec.*, October 24, 1903, p. 660).

Considers the physics of radium and ends by saying, "There is a possibility, perhaps almost a likelihood, that it may eventually become of inestimable value in medicine, but at present, sufficient is not known of its properties to pass a decided opinion. It is in its potential stage, but may emerge now at any time into an actual medical remedy of surpassing merit."

Radio-Activity and Radio-Therapy. (*Dietet. & Hyg. Gaz.*, November, 1903, p. 670).

The Therapeutic Possibilities of Radium. (*Boston M. & S. J.*, November 5, 1903, pp. 524-525).

An excellent summary of the then-current knowledge of radium and radium therapy.

Therapeutic Uses of Radium. (*St. Louis Med. Rev.*, December 19, 1903, pp. 437-438).

Mentions the possibilities of radium therapy and ends by saying, "Considering these facts, the ease at which radium rays may be applied to regions hardly accessible to the *x*-ray, and the faculty which radium possesses of imparting its properties to common substances, it would seem probable that the new metal will prove of wide-spread and practical value."

The Surgical Uses of Radium. (*J. Am. M. Assn.*, March 26, 1904, p. 832).

Discusses Dr. Truman Abbe's paper in the Washington Medical Annals, January, 1904. M. and Mme. Curie, the Discoverers of Radium. (*N. Eng. Med. Gaz.*, October, 1904, pp. 465-466).

A humorous editorial based on an article in the *British Homeopathic Monthly Review*, which stated, "Although M. and Mme. Curie are entirely absorbed in their laboratory work and do not concern themselves with medicine, we are able to state with some amount of pride, that both the father and grandfather of the former were homeopathic physicians."

The Action of Radium on Cancer (*J. Am. M. Assn.*, December 10, 1904, p. 1794).

Common Sense and Radium. (*M. Rec.*, May 14, 1904, p. 780).

A Forecast of Radium in Fiction. (*Med. Rec.*, April 9, 1904, pp. 580-581).

DISCUSSION

Dr. W. S. Newcomet. When I was called upon to discuss this paper I hardly knew at what angle it would be taken up. It appeared to me at first thought, that about 1906, most papers on this subject were either so scientific that most of us could not understand them, or else they were ordinary newspaper articles. However, some interesting articles were published. In 1903 Hemmer called attention to the fact that Professor Curie had recognized Colorado was rich in radium. He also, on page 20, gives this rather remarkable statement, that a French Company expected to produce nearly pure radium at $6,000 a gram! That is one fact that has not materialized, and there evidently was some slight miscalculation. It seems strange, too, that books published to 1906 on *x*-rays had several pages devoted to radium and the use of emanation as an inhalation for the cure of tuberculosis.

It is also interesting to see how conditions have changed, in the names which were adopted for the various applicators. If we review the early work of Abbe and Williams we find many of their suggestions are being used at the present time. In 1905 we find that Abbe reported his work on goiter. Dr. Williams, many of us remember, was one of the first to give us something of value. The American physicians had many other early works in this field which certainly have added credit to the whole profession.

PRELIMINARY REPORT ON A NEW TUBE FOR PRODUCING DUODENAL BLOCK

By ROSCOE G. VAN NUYS, M.D.

OAKLAND, CALIFORNIA

IN gastrointestinal work it has often occurred to me that it was easier to diagnose pathology in the stomach than in the duodenum, for the reason that the pylorus blocks for a time the passage of the opaque medium from the stomach. In the duodenum, on the other hand, there is nothing to block the barium suspension while the contour is being visualized.

I expressed this dissatisfaction to one of my surgical colleagues, Dr. Dexter M. Richards, and he suggested making an artificial block. This I set out to accomplish. At first we used an ordinary Rehfuss tube about which we had securely tied a tip of a finger cot. This was allowed to enter the duodenum in the usual way. A barium meal was then given by having the patient swallow the mixture. A Leur syringe was then attached and a barrel of air was injected which distended the finger cot. Under the fluoroscope the barium could then be expressed by digital pressure from the stomach and the duodenum filled proximal to the distended finger cot. This we felt would be of distinct value in the diagnosis of duodenal ulcer, diverticulum, dilated duodenum, adhesion, etc.

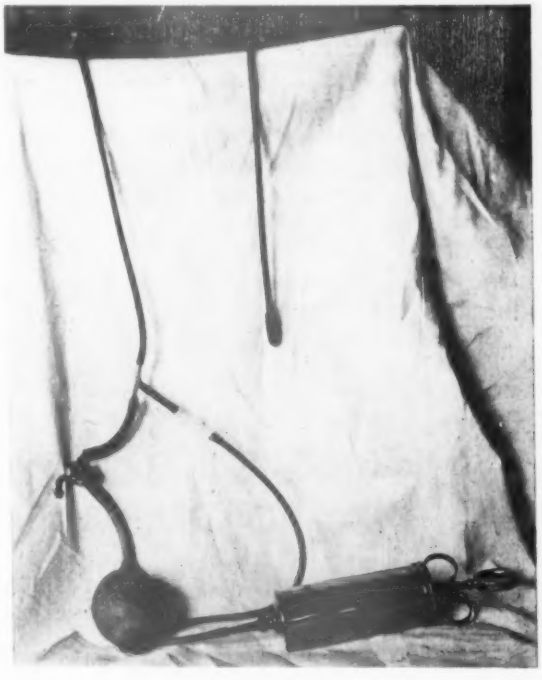


FIG. 2.

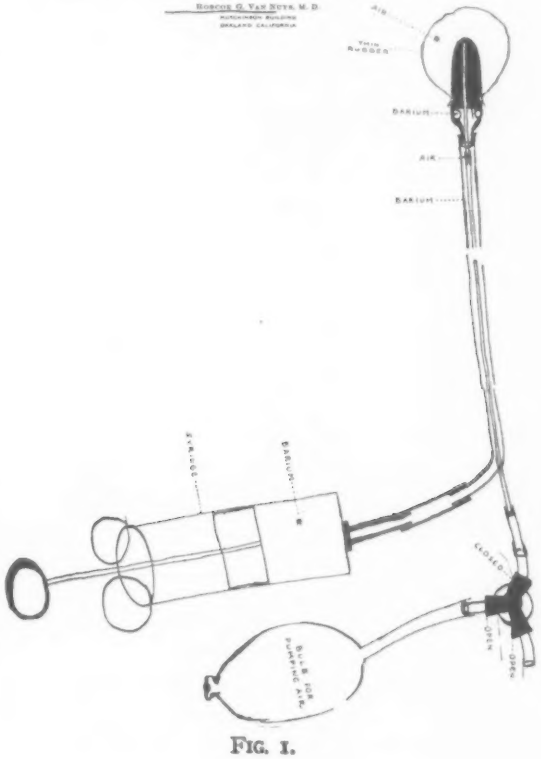


FIG. 1.

I felt, however, that a more useful tube might be devised. The principle of it is a tube within a tube. In other words, air can be pumped by a rubber bulb through a very fine tubing into the rubber tip and retained there by turning a three-way-cock. Behind this distended finger cot the larger outer tube terminates in holes through which the barium suspension can be forced by a large syringe, as can readily be seen in the following diagram.

We used the tube on several normals first of all and later on a few pathological cases. The number of these should be increased before reporting.

In the normal we find some incompetence

of the pylorus; some of the barium runs back into the stomach. With the fluoroscope in a thin individual it is interesting to watch the peristalsis of the duodenum outlined by the barium in the folds of the rugae against the bag of roentgenolucent air.

We also noted that in one case where we had distended the block a little more than usual, the patient, a nurse, complained of a heavy feeling which persisted for twenty-four hours. After removing the tube from this same patient we noted with the fluoroscope that the bowel seemed less active in passing the barium along. The advantages that we hope to realize are:

1. Better filling of the duodenum for the purpose of diagnosing ulcer, diverticulum, adhesions, tumor masses, etc.

2. Combination of gastric analysis and duodenal analysis with the roentgen examination so that a tube will have to be swallowed only once.

3. Examination of the duodenum throughout the entire length without the disadvantage of having the third portion covered by the shadow of the barium-filled stomach.

4. Magnesium sulphate, or other therapeutic and diagnostic agents, may be more effectively administered and retained in place.

5. While yet in the stomach a little air in the tip causes it to float to the surface if there is any hypersecretion. This quickly gives the level of the fluid.

6. The tube as constructed has a smaller tip than the Rehfuss or other duodenal tubes, and can be more readily pressed through the pylorus by digital pressure guided by the fluoroscope.

A SIMPLE DEVICE TO PREVENT THE OMISSION OF FILTERS IN DEEP ROENTGEN THERAPY*

By GEORGE E. PFAHLER, M.D.

PHILADELPHIA, PENNSYLVANIA

As the thickness and density of filters are increased, and with the increase in the potential energy used in deep roentgenotherapy, the dangers incident to the omission of the filter have correspondingly increased. No arguments will be needed to indicate the dangers of such omission. Ultimately we shall probably utilize separate outfits for deep roentgenotherapy distinctive from those used for superficial therapy, but comparatively few laboratories have reached a stage in which this is practical; and until that stage is reached corresponding caution must be used.

A simple device toward this end, though still not foolproof, consists in the attachment of a piece of red silk ribbon to the edge of the opening in the tube holder or shield, and above the point of insertion of the filters. This should be of sufficient length to permit it to drop through the opening provided no filter is in place to hold it up. The ribbon can be weighted by a small piece of aluminum or asbestos which will force it to drop quickly if not held up by the filter.

This same device can be used to indicate the omission of subsequent filters. For instance: if one at times uses 2 mm. of filter and at others 6, the 2 mm. filter can have attached to its bottom a green ribbon in like manner, so that when the subsequent and additional 4 mm. of aluminum are not inserted, the green ribbon will hang downward and indicate that only 2 mm. are in place. Since all of us keep our eyes on the patient and the tube outfit during the exposure, only a second or two could pass before this signal would be noticed.

*Read at the Twenty-Second Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Washington, D.C., Sept. 27-30, 1921.

THE AMERICAN JOURNAL OF ROENTGENOLOGY
H. M. IMBODEN, M.D., *Editor* · PAUL B. HOEBER, *Publisher*

Issued Monthly. Subscription, $6.00 per year. Advertising rates submitted on application. Editorial office, 480 Park Avenue, New York. Office of publication, 67-69 East 59th Street, New York.

Information of interest to all readers and lists of officers of The American Roentgen Ray Society and The American Radium Society will be found on the two pages preceding Table of Contents.

THIRD ANNUAL MEETING
EASTERN SECTION, THE AMERICAN ROENTGEN RAY SOCIETY
ATLANTIC CITY, N. J., JANUARY 26, 27, 28, 1922.
Headquarters, Meetings and Exhibits, Ritz-Carlton Hotel

RADIODERMATITIS

There is probably no subject of greater interest and importance to the roentgenologists today than that of radiodermatitis. More and more actual, supposed or alleged cases of radiodermatitis are developing throughout the country. For the sake of the advancement of our science, for the protection of the roentgenologists, and for the good of the public, it is most important that every possible precaution be taken to prevent this condition. We should also prevent the patients and their friends from assuming that any unfortunate result, of whatever nature, that develops in the course of treatment or examination of a patient, is due to the application of the rays.

Toward this end it is clearly our duty to use every possible precaution against the production of any dermatitis, excepting where it is definitely indicated. Likewise a careful study should be made of the principles governing roentgenization, namely the careful measurement of time by a timing clock, the careful measurement of distance by a rule or some other definite measuring instrument, without guessing at the distance. We must bear in mind that the rays decrease in intensity proportionate to the square of the distance and increase according to the square of the distance when the focal skin distance is *decreased*. The radiation value increases approximately according to the square of the voltage. Further we should be most careful as to the milliampereage and filtration, and be sure that we are actually using what is intended. It is most important that detailed and complete records be kept of what is done.

Any device that can be developed which will help to prevent the omission of a filter in therapeutics will be useful. The danger-ribbon previously described is one step in this direction. The electrical device shown by one of the exhibitors is another. The devices described by Driessen[1] and by Holzknecht[2] are further steps in the proper direction. Careful attention given to the patients to prevent the application of any irritants to the skin following roentgenization will go far towards eliminating some of the disagreeable experiences that all roentgenologists have.

Next it is very important that the term "*x*-ray burn" be eliminated from our vocabulary. It is incorrect. It is in no sense a burn. There is no heat applied, and the sooner we cease the use of this word the better it will be for both patients and operators. Therefore, one should never speak to a patient or to any of his friends, or even to other roentgenologists, of a "burn" or refer to any irritation of the skin as a "burn." The practicioners of medicine should be discouraged from referring to any irritation of the skin that develops in the course of the examination or treatment as a "burn," no matter how mild or how unimportant. It is practically impossible, without the history of exposure to roentgenization and without the elimination of other causes, to state that the irritation of the skin is due to roentgenization, no matter in what stage it is found, and in all other instances other possibilities should be considered by the consultants.

[1]Driessen. *Zentralbl. f. Gynäk.*, October 30, 1920, xliv, 1258.

[2]Holzknecht. *Münch. med. Wchnschr.*, February 20, 1920, 213.

Finally, the expert roentgenologist, for the good of roentgenologists and for the good of patients in general, should be most cautious about drawing conclusions as to neglect or incompetence, for great harm can be done to the progress of the science by the multiplication of lawsuits. Great injustice can be done to the roentgenologist who is falsely accused, for even though he is proven innocent he is put through a nervous strain and to the expenditure of time and money for which there is no recompense, and ultimately the very evidence that the expert uses he may find standing against him when some patient of his has had an unfortunate end result, even though this is no fault of the roentgenologist himself.

G. T. PFAHLER

PRELIMINARY PROGRAM OF MID-WINTER MEETING EASTERN SECTION A. R. R. S.

THURSDAY, JAN. 26, 8:15 P.M.

Address: Joseph A. Blake, M.D., New York.
Tumors of the Chest. L. Jaches, M.D. and H. Wessler, M.D., New York.
A Review of the X-Ray Diagnosis of Lesions of the Esophagus. Wm. H. Stewart, M.D., New York.
Standardization of X-Ray Reports. P. M. Hickey, M.D., Detroit.

FRIDAY, 9 A.M.

A Preliminary Report on some Experimental Work with Therapy of the Tonsils and Adenoids. C. A. Waters, M.D., and S. Crowe, M.D., Baltimore.
Injection of Normal and Obstructed Tear Sacs. H. P. Doub, M.D., Detroit.
Congenital Syphilis as shown in X-Ray Plates. R. N. Pierson, M.D., New York.
A Discussion of Abnormalities in the Sella Turcica. Walter Timme, M.D., New York.
The Report of the Committee of Safety on Electrical Dangers. Prof. John S. Shearer, Chairman, Ithaca, N. Y.

FRIDAY, 2 P.M.

The Interpretation of Bone Plates; The Differential Diagnosis of Tuberculosis, Syphilis and Osteomyelitis. Robert W. Lovett, M.D., Boston.
Abnormal Pulmonary Densities as an Aid in the Prognosis of Pulmonary Tuberculosis. Kennon Dunham, M.D., Cincinnati.
Foreign Bodies in the Esophagus. Willis F. Manges, M.D., Philadelphia.

SYMPOSIUM ON EDUCATION

Graduate Teaching. G. W. Holmes, M.D., Boston; L. Jaches, M.D., New York; Prof. J. S. Shearer, Ithaca, N. Y.
Undergraduate Teaching. Frederick H. Baetjer, M.D., Baltimore, and Henry K. Pancoast, M.D., Philadelphia.

FRIDAY, 8:15 P.M.

Address: Lewellys F. Barker, M.D., Baltimore.
The Annual Exhibit of Lantern Slides. [Those desiring to show slides should notify either the President or the Secretary of the Section.]

SATURDAY, 9 A. M.

Some High Voltage Problems. Frank Rieber, San Francisco.
The Organization of a Therapeutic Department. Harvey Gaylord, M.D., Buffalo.
A Résumé of the Physical Factors Concerned in Deep Therapy. Prof. John S. Shearer, Ithaca, N. Y.
Title to be Announced. Prof. Wm. Duane, Boston.
Biological Dosage. Francis Carter Wood, M.D., New York.
Topic to be Announced. Curtis F. Burnham, M. D., Baltimore.
Topic to be Announced. James T. Case, M.D., Battle Creek.

SATURDAY, 2 P.M.

Business Session.
A Practical Demonstration of Treatment Methods:
Therapy of Brain Tumors. Henry K. Pancoast, M.D., Philadelphia.
Therapy of the Thyroid Gland. G. W. Holmes, M.D., Boston.
Therapy of the Mammary Glands. George E. Pfahler, M.D., Philadelphia.
Therapy of the Tonsils and Adenoids. W. D. Witherbee, M.D., New York.

SATURDAY, 8 P.M.

DINNER; DANCE.

Complete programs will be sent to members of the American Roentgen Ray Society, and to others upon request.

CORRESPONDENCE

226 Michigan Street, Toledo, Ohio.

To the Editor:

During my absence in Europe there was sent to my office a number of copies of the old *American Quarterly of Roentgenology*. These were opened and the wrapper mislaid, so I was unable to trace the donor and consequently cannot acknowledge receipt of these valuable copies. Volume 1 of the *Quarterly* is especially valuable. I trust that the sender will communicate with me so that I may make proper acknowledgment.

H. W. DACHTLER
Librarian.

To the Editor:

I beg to report herewith the proceedings of the Second Annual Meeting of the Canadian Radiological Society, which was held in conjunction with the Ontario Radiological Society at Niagara Falls, from May 31st to June 2nd, after which we adjourned and went to Boston, where the meeting was reconvened with the North American Radiological Society meeting on the 3rd and 4th of June.

The attendance at the meeting was far in excess of our most sanguine expectations. The program, which was contributed to mainly by members of our own Society, also included valuable contributions from Dr. A. E. Barclay, Manchester; Drs. John Remer and Wm. H. Stewart, New York City; Dr. P. M. Hickey, Detroit; Dr. G. C. Sutherland, Mayo Clinic, and Professor J. S. Shearer of Cornell University.

The various officers elect for the coming year are: President, Dr. G. E. Richards, Toronto; Vice Presidents: L. J. Carter, Brandon (First); W. A. Wilkins, Montreal (Second), and Dr. C. W. Prowd, Vancouver (Third). The Executive Committee is composed of the retiring President, Dr. A. H. Pirie, Montreal (Chairman); Dr. L. T. Pariseau, Montreal, and Dr. L. K. Poyntz, Victoria, with Dr. Poyntz also re-elected Secretary-Treasurer.

One of the features of the meeting was the decision of the Society to provide some method of recognizing qualified ethical lay technicians, the details to be worked out by the Executive Committee, but it was suggested that they should be required to pass an examination and be given annual registration. When the detailed plan has been completed we shall be pleased to forward you a copy.

The members of the Society greatly appreciate the attendance at their meeting of some of the members of the American Roentgen Ray Society, and wish to give here a formal expression of their thanks, and to hope that the meetings in future will be honored by a larger representation from the A. R. R. S.

L. K. POYNTZ
Secretary-Treasurer.

---

10 Newton Place
Glasgow,
October 1, 1921.

To the Editor:

In the August number of your most excellent Journal, which I read regularly with much profit and pleasure, there appeared an interesting article by Drs. J. M. and C. L. Martin on "Roentgen Ray Treatment of Acne Vulgaris." There are certain points raised in the paper to which I should like to call attention.

First the writers "abandoned the use of the coil." While not expressly stating that an accurate technique "by which therapeutic results may be repeated over and over again" is impossible with the coil, it is clearly implied. Here I am afraid the authors have "tramped on my corns." I *like* the coil. I am satisfied that it is quite as good as the rotary transformer for treatment with rays of the hardness described, and I think it is superior to the transformer when hard rays are to be used. The coil will serve a Coolidge tube quite satisfactorily, and permit of results being exactly repeated, and for years my dosage has been measured by time. The time is occasionally checked by the pastille. The authors must not condemn the *coil* because of the vagaries of a *gas tube* or faulty *milliamperemeters.*

With regard to Hampson's, Holzknecht's and Sabouraud's meters for rays of medium hardness—those in question—I have found them all fairly accurate. They are not ideal,

but from the practical point of view they are reliable. I would not attempt a temporary epilation (ringworm) without using one of them. The authors use the "physiological dose" method as elaborated by Wintz of Erlangen. Wintz, however, had to deal with rays of an entirely different quality, having a hardness corresponding to a 16 inch equivalent spark more than threee times the length, and filtered through a screen more than twenty times the density of that here used. These pastille tests are not intended for rays of that quality.

The second point I would like to raise, is the actual dose prescribed. In the conditions given five minutes "will produce a mild degree of reaction." The phrase, I suppose, will be generally understood to mean a dose equal to 5 *H* or Sabouraud's tint B. This may not be the author's meaning, but I think I am right in assuming that it will be so understood in general.

Taking then their smallest dose—viz., three minutes, in a *fortnight* the patient will have received at least 9/5 or nearly twice the erythema dose, and he *might* have got three erythema doses. I would not repeat *one* erythema dose under a month; and in the above circumstances I would expect burns followed by late untoward results, such as telangiectasis.

Lastly, let me say that to the authors are due our thanks for calling attention to the fact that milliamperemeters require periodic checking, a fact very easily lost sight of.

JAMES R. RIDDLE

To the Editor:

It gives us great pleasure to receive the above letter which comes from a distant land in a spirit of friendly censure. We have expected similar criticism from the roentgenologists of our own country, since we realize that our technique is more radical than that now generally accepted.

As to the use of the coil, the writer admits that nothing definitely derogatory was said in our article concerning this piece of apparatus. The senior member of our firm operated four coils with gas tubes for many years with satisfactory results. We did imply, however, that the rays from the gas tube energized by a coil was a variable quantity, and it was for this reason that the American roentgenologists have, for the most part, changed over to the Coolidge tube energized by the transformer. Since the modern transformer with its rectifying switch sends a pulsating direct current through the tube and since it does away with the variations so likely to occur in the interrupter and in the resistance coil control, we feel that it is preferable for therapeutic work, especially when equipped with a current stabilizer.

As to measuring devices, it is our feeling that there is no measuring apparatus quite so accurate as the human skin, and even that structure is subject to variations within limits. Our dose calculations are based on the work of Witherbee and Remer, rather than on that of Wintz of Erlangen. We would like to call attention to the fact that the work of these experimenters was done with the American-made transformer and a Coolidge tube and that the voltage and filters used were those noted in our article. The unit used in this work is called a skin unit, which represents a dose just large enough to produce alopecia. Acording to the formulae worked out for ½ mm. of aluminum filter

$$\frac{\text{MA} \times \text{Sp. gap} \times \text{time}}{\text{Dist.}} = \frac{99}{20} = 1 \text{ skin unit}$$

If our factors are substituted here, the time needed for one skin unit is, in round numbers, two minutes. Now, according to the observations of Witherbee and Remer published in the October, 1920, issue of THE AMERICAN JOURNAL OF ROENTGENOLOGY, doubling the time with the filtration and factors that we use increases the dose by ¼. Therefore, with a four minute exposure, we would obtain 1-¼ skin units, which produces a mild erythema as illustrated by a photograph in the article just mentioned. A five minute exposure represents 1-⅜ skin units and some advanced cases of acne vulgaris do not show an erythema even after the use of this dose. A heavy piece of sole leather is placed beneath the ½ mm. of aluminum, and this probably reduces the skin effect by a small amount.

The advisability of repeating the doses mentioned in one week is also questioned. According to the work of Kingery published in the *Archives of Dermatology and Syph-*

ilis (1920), the residual effect at the end of seven days is about 20 per cent or 1/5 of the original dose. Now if 1-¼ skin units be added at this time the total amounts to about 1-9/20 skin units, which produces a definite erythema, but no vesiculation in the average skin.

Another factor that should be mentioned, is the size of the port of entry. Our work has been done with cones of moderate size. Larger doses can be given through small cones than through large ones in producing the same skin effect.

Summing up, we merely attempt to produce a mild erythema, which later gives place to a moderate tan and finally disappears. We feel that various skins require a rather wide variety of doses to produce this effect. The immediate results of this treatment seem superior to those obtained with long-continued fractional doses. One case of acne given an erythema dose just short of vesiculation twelve years ago, showed no untoward skin reaction when last seen one year ago. In examining our cases of skin malignancy which have been cured for five, six or seven years, we usually find the skin at the site of the lesions smooth and soft, though sometimes atrophic. Occasionally, telangiectases are observed. These patients received three or more skin units several years ago and rather marked reactions appeared at the time of treatment. The erythema produced in treating acne is of a much less degree than that produced in these cases. The reactions which appear as a result of the treatment are readily taken care of by the application of a mixture commonly called whitewash in this country. The formula for this mixture was obtained from the Massachusetts General Hospital and is given below:

Oxide of zinc	dr. iv
Glycerine	dr. ii
Phenol	dr. i
Aq. Calcis. qs. add	oz. vi

This wash seems to reduce the reaction to a minimum. We are not entirely convinced that serious later effects will follow the erythema dose when given in this manner.

J. M. and C. L. MARTIN

A CORRECTION

The paper entitled "Developmental Rests in the Cecum and Ascending Colon and their Roentgen Ray Diagnosis," by Dr. R. A. Payne and Mr. F. C. Trahar, published in the November JOURNAL, was read at the joint meeting of the Pacific Coast and the Western Section of the American Roentgen Ray Society, and not as stated.

Subscribers to THE AMERICAN JOURNAL OF ROENTGENOLOGY *visiting New York City, are invited to make the office of* THE JOURNAL (*69 East 59th Street, New York*) *their headquarters. Mail, packages or baggage may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; in this case, kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

BOOK REVIEWS

DIE ROENTGENDIAGNOSTIK DER INNEREN KRANKHEITEN. By Herbert Assmann, M.D. Pages 693; 613 illustrations in the text and 20 tables. F. C. W. Vogel, Leipzig, 1921.

Conservatism runs through all the pages of Assman's book. This perhaps is due not only to racial objective habits of thought, but also to the author's particular medical environment. Under the dominance of Strümpell at the Leipzig Medical Clinic, roentgen diagnosis is not regarded as an independent specialty, but as one of many clinical methods, all of which must be taken together to solve diagnostic problems. Accordingly the author's experiences here presented have been constantly compared and associated with all other processes of examination. Emphasis is laid upon the value of operative and necroptic control. We would have his proofs beyond cavil. "For," as he states in the preface, "I am of the opinion that by premature conclusions from or overvaluation of roentgen signs the method will only be prejudiced. I regard it as extraordinarily important that the roentgen examiner shall understand not only the possibilities of the method but also its limitations." Yet the author is not totally lacking in enthusiasm; it is merely restrained by his abiding regard for the truth. His interest is keen, his faith in the proven facts of roentgenology is confident, and this book of nearly 700 pages attests his respect for the *x*-ray.

The table of contents includes the circulatory system, mediastinum, respiratory organs, digestive tract, abdominal organs, urinary system, nervous system, bones and joints, muscles, .tendons, subcutaneous tissues.

To the heart and blood-vessels 133 pages are devoted. Methods of orthodiagraphy are fully set forth, together with tabulated standards, and the roentgen appearance of the circulatory apparatus both in health and disease are discussed *in extenso*.

His presentation of the more common respiratory diseases is admirably simple and clear. It is of interest to note that he takes issue with Rieder and Stürtz, who have many disciples, in their belief that pulmonary tuberculosis in adults commonly proceeds from the hilus toward the periphery retrogradely along the lymph channels, and that exaggeration of the upper lung markings is an important sign of early tuberculosis. Assmann holds rather with the school which attributes greater diagnostic value to mottling than to striations.

Regarding the diagnosis of pulmonary tuberculosis in general he says: "The great necessity is a knowledge of the underlying pathology. For accurate diagnosis great experience is required, not alone from many roentgenological examinations, but also by constant comparison with the clinical, and especially the necroptic, findings. This requirement cannot be emphasized sharply enough in view of the alacrity with which the roentgen diagnosis, for example, of 'tuberculous hilar glands' and 'peribronchial strands' is made in inexperienced quarters in cases that are not normal or at least not tuberculous. Illustrations have been published, stated to be characteristic for tuberculosis, in which, despite the most thorough examination, I could not discover the slightest changes."

Pulmonary tumors are dealt with rather briefly, and a wider review of the literature would have enhanced the value of this chapter.

The roentgenology of the gastrointestinal tract is covered quite thoroughly with 247 pages of text and illustration. As is usual with continental writers, indirect signs of disease are given prominence, but in some sections, notably that on duodenal ulcer, Assmann stresses the direct signs in almost the American manner, and gives due credit to Cole.

The chapter on the roentgenological signs of disease of the nervous system is limited in the main, of course, to the trophic changes observed in the osseous system. Various pathological conditions of the bones and joints proper are described succintly, but with some beautiful roentgenograms. His discussion of the urinary system is disappointingly brief.

A striking feature of the book is the excellence of the paper and the clarity of the illustrations. Coming as it does from a land that is surely less prosperous than our own, the typographical qualities of the book might well be brought to the attention of American publishers.

R. D. CARMAN

INDEX TO VOLUME VIII

Abdomen, pneuperitoneum as an aid in the differentila diagnosis of diseases of the left half of the, 65.

Abdomino-Cardiac, reflex sign of Livierato, as a means for determining the tonicity of the myocardium, Abstract, 422.

ABSTRACTS:

Amreich, I., The histological changes incident to radium and *x*-ray treatment of uterine carcinoma, 692.

Antoine, E. (Paris), Case of "appendicular sciatica," 421.

General and radiologic study of simple duodenal ulcer, 420.

Baejter, F. H., Roentgenological aspects of lower right quadrant lesions, 210.

Becerro de Bengoa, Radium therapy of cancer of the uterus, 425.

Birch-Hirshchfield, Lesions produced in the human eye by roentgen rays, 554.

Bryan, Lloyd, The *x*-ray as an aid in diagnosis of non-tubercular pulmonary conditions, 214.

Carman, R. D., The roentgen diagnosis and localization of peptic ulcer, 42.

Case, James T., Surgical physiology and pathology of the colon from the *x*-ray standpoint, 552.

Chase, Sumner B., The roentgen ray in the diagnosis of sinus disease, 89.

Clagett, A. V., The treatment of goiter with radium, 45.

Curtis, Arthur H., Radium treatment in gynecology, 47.

Davis, J. S., The radical treatment of *x*-ray burns, 93.

Denis, W., A study of the relative toxic effects produced by regional radiation, 94.

Duncan, Rex, Epithelioma of the lip, with observations and results in the treatment of eighty consecutive cases with radium, 92.

Du Pont, J., Slight fractures of the base of the acetabulum, 421.

Eden, T. Watts, and Provis, F. Lionel, Record of seventy-six cases of uterine fibroids and chronic metritis treated by the *x*-rays, 352.

Edling, Dr. Lars, On plastic means of application in radium therapy, 620.

Eggleston, E. L., Critical review of 500 cases of gastric and duodenal ulcer, 693.

Ewing, James, The structure of nerve tissue tumors with reference to radium therapy, 352.

Fischel, E., The use of radium in carcinoma of the face, jaws and oral cavity, 47, 213.

Forsell, Gösta, A plate holder for precise roentgenography in connection with fluoroscopy, 619.

Frank, Louis, Carcinoma in the cervical stump after supravaginal hysterectomy; and the radium treatment of carcinoma of the cervix, 352.

Frankl, O., The histological changes incident to radium and *x*-ray treatment of uterine carcinoma, 692.

Friedenwald, Julius, Roentgenological aspects of lower right quadrant lesions, 210.

Funk. Elmer H., Malignant diseases of the lung, 550.

Griffin, C. E., Artificial menopause induced by the *x*-ray, 48.

Greenough, Robert B., The treatment of tumors by *x*-rays and radium, 208.

Gunning, R. E. Lee, *X*-ray manifestations of diseases of the chest, 94.

Hampeln, (Riga), Symptomatology and diagnosis of primary malignant growths of the lung, 422.

ABSTRACTS:

Haret, Radiotherapy of sciatica, new technique, 91.

Hansson, H., Case of fracture of the cranium with accumulation of air in the cranial cavity, 619.

Hawes, John B., 2nd, Broncho-esophageal fistula and traction diverticulum, 552.

Heiberg, K. A., and Strandberg, Ove., Microscopic examination of the mucous membrane of the nose on patients under treatment for lupus vulgaris with universal arc-light-baths, 620.

Helm, The tabetic stomach under *x*-rays, 424.

Houdmont, H., and Dautrebande, L., The radioscopic examination of the heart, 351.

Hubeny, M. J., *X*-ray treatment of exophthalmic goiter, 213.

Ivy, A. C., Studies on gastric and duodenal ulcer, 693.

Japiot, P., and Bussy, L., Radiotherapy in interstitial keratitis, 620.

Johansson, S., A case of osteogenesis imperfecta with extended arteriosclerotic changes, 619.

Johnson, F. Hernaman, The immunizing effects of *x*-rays in carcinoma, 424.

The use of *x*-rays as immunity-raising agents before and after operation for cancer, 212.

Judd, E. S., Jejunal ulcer, 690.

Kingery, Lyle B., Saturation in roentgen therapy—its estimation and maintenance, 154.

Klason, T., Hemophilia and hemophilic arthropathy, 619.

Knox,Robert, Treatment by *x*-rays and radium, 423.

X-rays in the diagnosis of tumors of the thorax, 550.

Kohlmann, W., Radium in carcinoma of the uterus, 691.

Krupp, D. D., The *x*-ray as an essential guide for producing artificial pneumothorax in advanced cases of pulmonary tuberculosis, 46.

Laborde, A., Apparatus employed in radium-therapy, 426.

Ledoux and Caillods, Sacralization of the fifth lumbar vertebra, 353.

Lehmann, J. J., Carcinoma dosage, with especial consideration of carcinoma of the breast, 354.

Leighton, W. E., Inoperable cancer, 213.

Livierato, P. E., (Genoa), The abdomino-cardiac reflex (sign of Livierato) as a means for determining the tonicity of the myocardium, 422.

Lovett, Robert W., and Wollach, S. B., Roentgenographic appearance, diagnosis, and pathology of some obscure cases of bone lesions, 41.

Lumiere, A., The precision of radiographic images, 425.

Martin, Charles L., A study of the relative toxic effects produced by regional radiation, 94.

Marty, L. A., The modern treatment of malignancies, 46, 212.

Mayo, Charles H., The thyroid and its diseases, 551.

Menard and Postel and Contremoulins, Dangers of radiography to third persons, 554.

Morton, Reginald, *X*-ray radiation and cancer, 423.

Ormerod, F. C., On the treatment of oriental sore by *x*-rays, 91.

Paisseau and Solomon, Radiologic aspects of influenza, pneumonia and bronchopneumonia, 423.

Palefski, I. O., Intubation and visualization of the duodenum with the duodenal tube, 693.

Panner, H. J., On the *x*-ray examination of duodenal ulcer, 619.

Pontano, T., Contributa alla conoscenza clinica e radiologica della sifilide polmonare.—A. S. Giordano: R. D. Carman, 420.

ABSTRACTS:
Prime, Frederick, The effect of combined radiation and heat on neoplasms, 89.
Quick, Douglas, The combination of radium and the *x*-ray in certain types of carcinoma of the breast, 210.
Clinical results of treatment of nerve tissue tumors by radium, 351.
Rinehart, D. A., Evidence of gastrointestinal disease as revealed by roentgenological examination of the digestive tract, 46.
Roberts, D., The roentgen diagnosis of gall-bladder lesions, 694.
Roberts, J. E. H., Oxygen inflation of the peritoneal cavity for radiographic purposes, 354.
Roberts, Percy Willard, Syphilitic and tuberculous joints, 89.
Rohdenburg, G. L., The effect of combined radiation and heat on neoplasms, 89.
Schlecht, H., (Kiel), Relative values of occult blood and radiography in the diagnosis of cancer of the stomach, 422.
Schmitz, Henry, The indications for radium therapy in surgical conditions of the pelvic organs, 47.
Semon, H. C., The *x*-ray treatment of acne vulgaris, 214.
Sievert, Rolf M., The distribution of the intensity of the primary gamma-radiation in the neighborhood of medical radium preparations, 620.
Simon, Adhesions in the cecal tract diagnosed by *x*-rays, 425.
Simon, M., On the *x*-ray diagnosis of gallstones in the common duct, 619.
Sittenfield, M. J., New roentgenotherapy in cancer, 95.
Soiland, A., Cancer of the lip, 95.
Spencer, Hunter B., Roentgen therapy, 45.
Steindler, Arthur, Congenital malformations and deformities of the hand, 90.
Stevenson, Walter C., The effects of radium treatment on war injuries in the neighborhood of nerves, 353.
Ström, S., A case of arthropatia psoriatica, 619.
(Stockholm), Roentgen differential diagnosis between osteitis fibrosa, solitary bone-cyst and tumor, 424.
Taft, A. Robert, The comparative value of radium and *x*-rays in the treatment of keloid, nevi, Angioma, leukoplakia and other lesions of the skin and mucous membrane, 92.
The protection of roentgenologic workers, 550.
Truchot, Radiotherapy of sciatica, new technique, 91.
Ulrici, H., So-called hilus tuberculosis, 353.
Vilrande, G. E., Observations on the treatment of neoplasm, 213.
Vogt, Roentgenologic proof of extra uterine life, 622.
Warnekros, Attitude and mechanism of expulsion in breech presentation, 622.
Pregnancy and labor in roentgen pictures, 690.
Spontaneous change of position of full-term fetus during labor, 622.
The third stage of labor in roentgenograms, 621.
Weibel, Study of the third stage of labor in roentgenograms, 622.
(Vienna), Treatment of cancer of the uterus with the symmetry apparatus, 553.
Weinberg, Joseph A., The influence of the exposure of the roentgen ray on the progress of tuberculosis, 95.
Wilkins, W. A., The diagnostic of the *x*-ray examination in pulmonary tuberculosis, 93.

ABSTRACTS:
Withers, Sanford, Carcinoma of the eyelids treated with radium, 351.
Accessory sinuses, head-rest for the roentgenography of the, 402.
Acetabulum, the, slight fractures of the base of, 421.
Acne vulgaris. *x*-ray treatment of, Abstract, 214.
Adenoids, *x*-ray treatment of tonsils and, 25.
Adenocarcinoma of stomach revealed by roentgenograms, but not palpable on exploration by the surgeon, 480.
Adhesions in the cecal tract diagnosed by *x*-rays, Abstract, 425.
Acne vulgaris, roentgen-ray treatment of, 468.
Adult mammalian brain, effect of radium emanation on, 536.
Allison, R. G., The clinical importance of the different types of pulmonary tuberculosis as determined by roentgen examination, 103.
X-ray treatment of toxic goiter, 635.
Alvarez, Walter C., Peristalsis in health and disease (first Caldwell lecture), 1.
The use of CO_2 in pneumoperitoneum, 71.
American literature on radium and radium therapy prior to 1906, 766.
Aneurysm of the aorta and abscess of the tracheobronchial lymph glands, 269.
Apical field on the chest radiogram, a suggestion for improving the visibility of, 602.
Arthropatia psoriatica, a case of, Abstract, 619.

Bagg, Halsey J., The effect of radium emanation on the adult mammalian brain, 536.
Beard, A. H., *X*-ray treatment of toxic goiter, 635.
Blaine, Edward S., An *x*-ray burn of third degree followed by rapid healing, 183.
The roentgenological aspect of Sprengel's deformity, 654.
Boggs, Russell H., Treatment of carcinoma of the breast by imbedding radium supplemented by *x*-ray, 20.
Bone density, studies in reduction of, 355.
Bone lesion, roentgenographic appearance, diagnosis, and pathology of some obscure cases of, Abstract, 41.
Bonney, T. S., Dislocation of the semilunar bone, 24.
BOOK REVIEWS:
Assmann, Herbert, Die roentgendiagnostik der innern krankheiten, 786.
Blakewell, Charles M., Story of the American Red Cross in Italy, the, 40.
Carman, Russell D., The roentgen diagnosis of diseases of the alimentary canal, 549.
Dauvillier, A., Recherches spectrométrique, sur les rayons *x*, 87.
Holmes, George W., roentgen interpretation:—a manual for students and practitioners, 350.
Köhler, Dr. Alban, Grenzen des normalen und anfaenge des pathologischen im roentgenbilde, 284.
Keen, William Williams, Surgery, its principles and practice, 349.
Knox, Alice Vance, and Knox, Robert, General practice and *x*-rays. A handbook for the general practitioner and student, 419.
Law, Frederick M., Mastoids, roentgenologically considered, 689.
Overend, Walker, The radiography of the chest. Vol. I.—Pulmonary tuberculosis, 207.
Ruggles, Howard E., Roentgen interpretation:—a manual for students and practitioners, 350.
Tousey, Sinclair, Medical electricity, roentgen rays, and radium, 549.

Boutros, Amin, A simple drying rack for films, 608.
Bowen, David Ralph, Some accessories to the Potter-Bucky diaphragm, 343.
Brain, effect of radium radiation on the adult mammalian, 536.
Gunshot injuries to the, 445.
Tumor, diagnosis of, by pneumoventriculography, 188.
Bray, H. A., A suggestion for improving the visibility of the apical field on the chest radiogram, 602.
Breast, radium in the treatment of carcinoma of, as an adjunct to surgery, 668.
Treatment of carcinoma of, by imbedding radium supplemented by *x*-ray, 20.
Breech presentation, attitude and mechanism of expulsion in, Abstract, 622.
Bronchiectasis and lung abscess after direct injection of bismuth mixture through the bronchoscope, roentgenographic studies of, 49.
Broncho-esophageal fistula and traction diverticulum, Abstract, 552.
Bronchus, foreign body in, for fifteen years, 191.
Bryan, Lloyd, Preliminary report on the effects of roentgen rays on gastric hyperacidity, 623.
Bucky diaphragm principle applied to radiology of the spine, 61.

Calcification, intracranial, 77.
Caldwell lecture, first: Peristalsis in health and disease, 1.
Cancer, inoperable, Abstract, 213.
New roentgenography in, Abstract, 95.
Of the rectum, the treatment of, by radium, 746.
Of the stomach, relative values of occult blood and radiography in the diagnosis of, Abstract, 422.
Of the uterus, radium therapy of, Abstract, 425.
Treatment of, with the symmetry apparatus, Abstract, 553.
Personal experience with the application of the newer roentgen therapy in, 232.
X-ray radiation and, Abstract, 423.
Carcinoma, histological changes incident to radium and *x*-ray treatment of uterine, Abstract, 692.
Immunizing effects of *x*-rays in, Abstract, 424.
In the cervical stump after supravaginal hysterectomy; and the radium treatment of carcinoma of the cervix, Abstract, 352.
Of the breast, carcinoma dosage, with especial consideration of, Abstract, 354.
Combination of radium and the *x*-ray in certain types of, Abstract, 210.
Radium combined with *x*-ray treatment in, 661.
Treatment of, by imbedding radium supplemented by *x*-ray, 20.
Of the cervix, a histological study of the effects of radium on, 604.
Of the eyelids treated with radium, Abstract, 351.
Of the face, jaws and oral cavity, the use of radium in, Abstract, 47, 213.
Cardiac studies, roentgen ray, 295.
Carman, Russell D., adenocarcinoma of the stomach revealed by roentgenograms but not palpable on exploration by the surgeon, 480.
Aneurysm of the aorta and abscess of the tracheobronchial lymph qlands, 269.
Benign and malignant gastric ulcers from a roentgenologic viewpoint, 695.
Hemangioma of the duodenum, 481.
Making and filing of records in the section on roentgenology in the Mayo Clinic, 372.
Case, James T., A review of three years' work and articles on pneumoperitoneum, 714.
Cecum and ascending colon, developmental rests in, and their roentgen-ray diagnosis, 643.
Chamberlain, W. Edward, Pelvimetry by means of the roentgen ray, 272.
Chase, Carroll, American literature on radium and radium therapy prior to 1906, 766.
Chest cases, two unusual, 31.
Value of lateral and oblique studies of the, 106.
Radiogram, A suggestion for improving the visibility of the apical field on the, 602.
X-ray manifestations of diseases of the, Abstract, 94.
Christie, Arthur C., The diagnosis of primary tumors of the lung, 97.
CO_2, Use of in pneumoperitoneum, 71.
Coagulation mechanism, influence of *x*-ray organ stimulation on, 179.
Cohn, Isidore, Observations on the normally developing shoulder, 721.
Congenital atresia of the esophagus, 319.
Malformations and deformities of the hand, Abstract, 90.
Non-rotation of the stomach, 383.
Coolidge, W. D., The Kearsley stabilizer, 590.
Cork, J. M., *X*-ray spectra and the structures of matter, 393.
CORRESPONDENCE:
James R. Biddle, 784; W. D. Coolidge, 487; E. W. Dachtler, 783; G. Leslie Griffiths, 488; Howard C. Head, 548; P. W. Hickey, 487; G. W. Holmes, 487; J. M. and C. L. Martin, 785; George M. Niles, 548; H. K. Pancoast, 487; Geoffrey Pearce, 611; L. K. Poyntz, 611; 783; J. S. Shearer, 487, 611; J. T. Warner, 611.
From committee on safety, 487.
Paris letter, Dr. Ledoux-Lebard, 37.
Reply to criticism of formulae and methods of determination of *x*-ray dosage, John Remer and William D. Witherbee, 417.

Dachtler, H. W., Diverticulum of the lower portion of the esophagus, 389.
Deep radiography and its realization with a French apparatus, Abstract, 620.
Dermatology, the *x*-ray in, 476.
Dessauer, Friedrich, My studies on the physical foundations of deep therapy treatment, 578.
Diaphragm, Potter-Bucky, some accessories to, 343.
343.
Bucky, 340.
Discussion following symposium on artificial pneumoperitoneum, 134.
On therapy, 279.
On papers of Drs. Kirkendall and Pfahler, 671.
Of paper of J. H. Williams, 345.
Distribution of the intensity of the primary gamma-radiation in the neighborhood of medical radium preparations, Abstract, 620.
Diverticulum of the lower portion of the esophagus, report of a case of, 389.
Dock, George, *X*-ray work from the viewpoint of an internist, 321.
Dormody, Hugh F., Preliminary report on the effects of roentgen rays on gastric hyperacidity, 623.
Dosage in radium therapy, 674.
Doyle, Alfred S., Traumatic pneumocranium, 73.
Dunham's fans in a roentgen-ray study of granite dust inhalation, 560.
Dunham, H. Kennon, *X*-ray examination of the chest and an *x*-ray classification of pulmonary tuberculosis, 427.
Duodenum, hemangioma of the, 481.
Block, preliminary report on a new tube for producing, 779.

Dust inhalation in the granite industry, A roentgen study of, 244.

Eczema group, The roentgen-ray treatment of the, 520.
Editorials:
Acta radiologica, a new publication, 610.
Addendum, Dr. Alfred S. Doyle, 145.
Anthology, of malignancy, 610.
Caldwell Lecture, the, 36, 143.
Dosage measurement, J. S. Shearer, 145.
Electrical dangers in *x*-ray laboratory, J. T. Warner, 612.
Imbedding radium throughout different parts of the body in malignancy, Russell H. Boggs, 687.
Meetings:
Annual of Central Section A. R. R. S., 36, 84; report of, 143.
Annual of Western Section A. R. R. S., 84, 143, 204, 283; report of, 416.
Canadian Radiological Society, 206.
Externeships at Mount Sinai, 348.
Italian society of medical radiology, third congress of, 206.
Midyear of Radiological Society of North America, 417.
Second annual of Eastern Section A. R. R. S., 36; report of, 86.
Sixth annual of American Radium Society, 205; obituary resolutions, 490.
Third annual of Eastern Section A. R. R. S., preliminary program, 782.
Twenty-second annual, of A. M. A., 609.
Twenty-second annual of the American Roentgen Ray Society, 142, 203, 282, 346; provisional program, 414; railroad information, 485.
New committees, 204.
Note on the Bücky-Potter diaphragm, 416.
Obituary:
Albers-Schönberg, Dr. Henrich Ernst, of Hamburg, 348.
Bruce, Dr. William Ironside, 489.
Harris, Lawrence Hirschel, 84.
Radiodermatitis, 781.
Report of committee on teaching, 85.
Twenty-fifth anniversary of the discovery of the *x*-ray, 85.
X-ray work from the viewpoint of an internist, 347.
Eichenlaub, F. J., The roentgen-ray treatment of the eczema group, 520.
Enzyme mobilization, selective organ stimulation by roentgen rays, 175.
Epthelioma of the lip, with observations and results in the treatment of eighty consecutive cases with radium, Abstract, 92.
Esophagus, congenital atresia of the, 319.
Report of a case of diverticulum of the lower portion of the, 389.
Evans, William A., The value of lateral and oblique studies of the chest, 106.
Ewing, James, Tumors of nerve tissue in relation to treatment by radiation, 497.
Exophthalmic goiter, *x*-ray treatment of, Abstract, 213.
Extra bones in the wrist and ankle found by roentgen ray, 569.
Eye, human, lesions produced in, by roentgen rays, Abstract, 554.

Failla, Gioacchino, The absorption of radium radiations by tissues, 215.
Dosage in radium therapy, 674.
Films, simple drying rack for, 608.
Filters, simple device to prevent the omission of, in deep roentgen therapy, 780.
Fistula, gastrocolic, 516.
Fracture of the cranium with accumulation of air in the cranial cavity, Abstract, 619.
Fractures of the pelvis, 511.

Gall-bladder lesions, the roentgen diagnosis of, Abstract, 694.
Gas cases, chronic, *x*-ray findings in the, 193.
Tubes, simple and practical method for the rapid hardening of, 112.
Gastric hyperacidity, preliminary report on the effects of roentgen rays on, 623.
Ulcer not shown by roentgen ray, but found at operation, 480.
Gastrocolic fistula, 516.
Gastrointestinal disease as revealed by roentgenological examination of the digestive tract, evidence of, Abstract, 46.
Tract, An analysis of eleven hundred roentgen examinations of, 315.
Genito-urinary pathology, report of two interesting cases of, 641.
Goiter, the treatment of, with radium, Abstract, 45.
Toxic, pathological classification of thyroid gland diseases with radium treatment in, 755.
X-ray treatment of, 635.
Golden, Ross, Syphilis of the lungs, its radiographic findings and their pathological basis, 502.
Grandy, C. C., Fractures of the pelvis, 511.
Granite dust inhalation, Dunham's fans in a roentgen-ray study of, 560.
Industry, roentgen study of dust inhalation in the, 244.
Grier, G. W., Head-rest for the roentgenography of the accessory sinuses, 402.
Groeschel, L. B., Gastrocolic fistula, 516.
Report of two interesting cases of genito-urinary pathology, 641.
Gunshot injuries to the brain, 445.
Gynecology, radium treatment in, 47.

Health and disease, peristalsis in (first Caldwell lecture), 1.
Heart and its vascular pedicle, some recent advances made in France on the technique of the roentgen diagnosis of diseases of the, 491.
Hemangioma of the duodenum, 481.
Hemophilia and hemophilic arthropathy, Abstract, 619.
Hickey, Preston M., Intralaryngeal application of radium for chronic papillomata, 155.
Hilus tuberculosis, so-called, Abstract, 353.
Hirsch, I. Seth, Foreign body in the bronchus for fifteen years, 191.
Hirschsprung's disease, 186.
Hodgson, Millard B., Remarks on the measurements of scattered radiation, 338.
Holmes, George W., Some observations on the treatment of hyperthyroidism with *x*-rays, 730.
Some remarks on the present status of *x*-ray therapeutics, 522.
Hyperthyroidism, some observations on the treatment of, with *x*-rays, 730.
Hypertrophy of the prostate, *x*-ray treatment of, 292.

"Impex" *x*-ray plate, reduction of radiographic exposure to one twenty-fifth of the normal amount by means of, 528.
Intracranial calcification, 77.
Intralaryngeal application of radium for chronic papillomata, 155.
Intubation and visualization of the duodenum with the duodenal tube, Abstract, 693.

Jarvis, D. C., A roentgen study of dust inhalation in the granite industry, 244.
Dunham's fans in a roentgen-ray study of granite dust inhalation, 560.
Jejunal ulcer, Abstract, 690.

Kaufman, Julius, Total radiation falling on surfaces exposed to point sources, 390.
Kearsley stabilizer, 509.
Kesmodel, Karl F., Primary sarcoma of the vertebrae, with report of four cases, 573.
Kidneys, remarks on the technique of the roentgen examination of the, 115.
Roentgenological studies of injected, 704.
Kinney, Lyell C., Congenital non-rotation of the stomach, 383,
Kirkendall, Ben R., Radium in the treatment of carcinoma of the breast as an adjunct to surgery, 668.

Labor, spontaneous change of position of full-term fetus during, Abstract, 622.
Lafferty, Robert H., An analysis of eleven hundred roentgen examinations of the gastro-intestinal tract, 315.
Lambert, John H., Report of a case of osteoma, 483.
Lane, C. Guy, The *x*-ray in dermatology, 476.
Lawrence, W. S., Remarks on the technique of the roentgen examination of the kidneys, 115.
Leather-bottle stomach (linitis plastica), 163.
Ledoux-Lebard, Paris letter, Editorial, 37.
Le Master, C. A., A modification of technique for radiographing upper molar, 659.
Leukemia, Treatment of, 629.
Levy, Leonard and Baker, T. Thorne, The reduction of radiographic exposures to one twenty-fifth of the normal amount by means of the "Impex" *x*-ray plate, 528.
Levy, Sidney H., A simple and practical method for the rapid hardening of gas tubes, 112.
LeWald, Leon T., Leather-bottle stomach (linitis plastica.), 163.
Lim, W. K., Roentgenological studies of injected kidneys, 704.
Lip, cancer of the, Abstract, 95.
Loucks, R. E., Pathological classification of thyroid gland diseases with radium treatment in toxic goiter, 755.
Lumbar, fifth, sacralization of the, Abstract, 353.
Lung, malignant diseases of the, Abstract, 550.
Diagnosis of primary tumors of the, 97.
Symptomatology and diagnosis of primary malignant growths of, Abstract, 422.
Syphilis and syphilitic-tuberculous symbiosis in the lungs, the *x*-ray shadows of, 259.
Of the, its radiographic findings and their pathologic basis, 502.
Lymphatic diseases in the same family, with roentgen findings, two cases of, 514.
Lynah, Henry L., Roentgenographic studies of bronchiectasis and lung abscess after direct injection of bismuth mixture through the bronchoscope, 49.
Lyons, H. R., The use of radium in the treatment of myxomatous nasal polyps, preliminary report, 407.

Macmillan, A. S., Radiography of the mastoid, 399.
Malignancies, modern treatment of, Abstract, 46, 212.
Malignant diseases, clinical results from the newer technique of deep roentgentherapy in malignant diseases, 236.
Mann, Hubert, A simple and practical method for the hardening of gas tubes, 112.
Martin, Charles L., Roentgen ray cardiac studies, 295.
Martin, J. M. and Charles L., Roentgen ray treatment of acne vulgaris, 468.
Martinez, Gonzales, Some recent advances made in France on the technique of the roentgen diagnosis of diseases of the heart and its vascular pedicle, 491.
Mastoid, radiography of the, 399.
Mayo Clinic, making and filing of records in the section on roentgenology, 372.
McClure, C. W., Observations on the behavior of the normal pyloric sphincter in man, 158.
McKinley, G. A., *X*-ray treatment of toxic goiter, 635.
Merrill, A. S., Diagnosis of a brain tumor by pneumoventriculography, 188.
Microscopic examination of the mucous membrane of the nose on patients under treatment for lupus vulgaris with universal arc-light-baths, Abstract, 620.
Molar, A modification of technique for radiographing the upper, 659.
Monometer and flow-volumeter for transuterine peritoneal inflation to determine patency of fallopian tubes in cases of sterility, 459.
Morrison, L. B., Report of a case of osteosarcoma, 565.
Mount Sinai, Externeships at, Editorial, 348.
Murphy, John T., Intracranial calcification, 77.
Myxomatous nasal polyps, use of radium in treatment of, 407.

Nasal polyps, use of radium in treatment of myxomatous, 407.
Neoplasm, observations on the treatment of, Abstract, 213.
Effect of combined radiation and heat on, Abstract, 89.
Pulmonary, an unusual case of, 555.
Nerve tissue, tumors in relation to treatment by radiation, 497.
Newell, R. R., Pelvimetry by means of the roentgen ray, 272.
Non-tubercular pulmonary conditions, the *x*-rays as an aid in diagnosis of, Abstract, 214.
Norris, Charles C. and Rothschild, Norman S., A histological study of the effects of radium on carcinoma of the cervix, 604.

Oriental sore, on the treatment of, by *x*-rays, Abstract, 91.
Osteochondromata, multiple, 462.
Osteogenesis imperfecta with extended arteriosclerotic changes, Abstract, 619.
Osteoma, report of a case of, 483.
Osteosarcoma, report of a case of, 565.

Papillomata, intralaryngeal application of radium for chronic, 155.
Payne, R. A., Developmental rests in cecum and ascending colon and their roentgen-ray diagnosis, 643.
Pelvimetry by means of the roentgen ray, 272.
Pelvis, fracture of, 511.
Pneumoperitoneum of the, gynecological studies, 12.

Peristalsis in health and disease, (first Caldwell lecture), 1.
Peritoneal cavity, oxygen inflation of, for radiographic purposes, Abstract, 354.
Peterson, Reuben, Pneumoperitoneum of the pelvis, gynecological studies, 12.
Peterson, William F., Selective organ stimulation by roentgen rays: enzyme mobilization, 175.
Pfahler, George E., An inexpensive radium capsule holder, 30.
A new device for increasing the protection of both the patient and the roentgenologist, 239.
A simple device to prevent the omission of filters in deep roentgen therapy, 780.
Clinical results from the newer technique of deep roentgentherapy in malignant diseases, 236.
New roentgenographic technique for the study of the thyroid, 81.
Radium combined with *x*-ray treatment in carcinoma of the breast, 661.
Pfender, C. A., Washington, 409.
Phemister, D. B., Studies in reduction of bone density, 355.
Physics to radiation therapy, the relation of the science of, 285.
Pillsbury, Henry C., *X*-ray findings in the chronic gas cases, 193.
Pirie, A. Howard, A retinometer, 75.
Extra bones in the wrist and ankle found by roentgen rays, 569.
Plateholder for precise roentgenography in connection with fluoroscopy, Abstract, 619.
Pneumocranium, traumatic, 73.
Pneumoperitoneum, A review of three years' work and articles on, 714.
As an aid in the differential diagnosis of diseases of the left half of the abdomen, 65.
Of the pelvis, 12.
Subphrenic, produced by intra-uterine insufflation of oxygen as a test of patency of the falliopian tubes in sterility and allied gynecological conditions, 120.
Technique, a table designed for the simplification of, 404.
The detection of retroperitoneal masses by the aid of, 129.
Use of CO_2 in, 71.
Pneumoventriculography, diagnosis of a brain tumor by, 188.
Potter-Bucky diaphragm, some accessories to the, 343.
Potter, Hollis E., Bucky diaphragm principle applied to radiography of the spine, 61.
Pott's disease, suboccipital, 632.
Pritchard, J. S., An unusual case of pulmonary neoplasm, 555.
Prophylactic *x*-ray treatments, the value of, 199.
Protection of both the patient and roentgenologist, new device for increasing, 239.
Pulmonary neoplasm, an unusual case of, 555.
Tuberculosis as detemined by roentgen examination, clinical importance of the different types of, 103.
The diagnostic value of the *x*-ray examination in, Abstract, 93.
X-ray examination of the chest and an *x*-ray classification of, 427.
X-ray treatment of, 241.
Pyloric sphincter, observations of the behavior of the normal, in man, 158.

Quick, Douglas, The treatment of cancer of the rectum by radium, 746.

Radiation, (super) and delayed reactions, 466.
A study of the relative toxic effects produced by regional, Abstract, 94.
Scattered, remarks on the measurements of, 338.
Therapy, the relation of the science of physics to, 285.
Total, falling on surfaces exposed to point sources, 390.
Tumors of nerve tissue in relation to treatment by, 497.
Radiographic exposures, reduction of, to one twenty-fifth of the normal amount by means of the 'Impex" *x*-ray plate, 528.
Findings and their pathologic basis, syphilis of the lungs, 502.
Images, precision of, Abstract, 425.
Radiographing upper molar, a modification of technique for, 659.
Radiography, dangers of, to third persons, Abstract, 554.
Intensity of scattered x-rays in, 328.
Of the mastoid, 399.
Of the spine, the Bucky diaphragm principle applied to, 61.
The effects of scattered *x*-rays in, 589.
Radiologic aspects of influenza, pneumonia and bronchopneumonia, Abstract, 423.
Radioscopic (the) examination of the heart, Abstract, 351.
Radiotherapy in interstitial keratitis, Abstract, 620.
Collateral treatment of malignant patients undergoing, 138.
Radium and radium therapy prior to 1906, American literature on, 766.
And *x*-rays in the treatment of keloid, nevi, angioma, leukoplakia and other lesions of the skin and mucous membrane, comparative value of, Abstract, 92.
Capsule holder, an inexpensive, 30.
Clinical results of treatment of nerve tissue tumors by, Abstract, 351.
Combined with *x*-ray treatment in carcinoma of the breast, 661.
Emanation, the effect of, on the adult mammalian brain, 536.
In carcinoma of the uterus, Abstract, 691.
In the treatment of carcinoma of the breast as an adjunct to surgery, 668.
Intralaryngeal application for chronic papillomata, 155.
On carcinoma of the cervix, a histological study of the effects of, 604.
Therapy, on plastic means of application in, Abstract, 620.
Radiations, absorption of, by tissues, 215.
Supplemented by *x*-ray, the treatment of carcinoma of the breast by imbedding, 20.
Therapy, apparatus employed in, Abstract, 426.
Dosage in, 674.
In surgical conditions of the pelvic organs, the indications for, Abstract, 47.
Of cancer of the uterus, Abstract, 425.
The treatment of cancer of the rectum by, 746.
The treatment of goiter with, Abstract, 45.
Treatment in gynecology, Abstract, 47.
On war injuries in the neighborhood of nerves, the effects of, Abstract, 353.
Pathological classification of thyroid gland diseases with, in toxic goiter, 755.
Use of, in treatment of myxomatous nasal polyps, preliminary report, 407.
Record of seventy-six cases of uterine fibroids and chronic metritis treated by the *x*-rays, Abstract, 352.

Rectum, Treatment of cancer of, by radium, 746.
Retinometer, A, 75.
Retroperitoneal masses, Detection of, by aid of pneumoperitoneum, 129.
Reynolds, L., Observations on the behavior of the normal pyloric sphincter in man, 158.
Richards, Charles M., Suboccipital Pott's disease, 632.
Two cases of lymphatic disease in the same family, with roentgen findings, 514.
Roentgen diagnosis and localization of peptic ulcer, Abstract, 42.
Of diseases of the heart and its vascular pedicle, some recent advances made in France on the technique of, 491.
Roentgen differential diagnosis between osteitis fibrosis, solitary bone cyst an tumor, Abstract, 424.
Roentgen examination, clinical importance of the different types of pulmonary tuberculosis as determined by, 103.
Of the gastro-intestinal tract, analysis of eleven hundred, 315.
Findings, two cases of lymphatic diseases in the same family with, 514.
Roentgenographic appearance, diagnosis, and pathology of some obscure cases of bone lesions, Abstract, 41.
Studies of bronchiectasis and lung abscess after direct injection of bismuth mixture through the bronchoscope, 49.
(New) technique for the study of the thyroid, 81.
Roentgenograms, study of the third stage of labor, in, Abstract, 622.
The third stage of labor in, Abstract, 621.
Roentgenologic proof of extrauterine life, Abstract, 622.
Viewpoint, benign and malignant gastric ulcer from a, 695.
Workers, the protection of, Abstract, 550.
Roentgenological aspects of lower right quadrant lessions, Abstract, 210.
Aspect of Sprengel's deformity, 654.
Studies of injected kidneys, 704.
Roentgenologist, new device for increasing the protection of both the patient and the, 239.
Roentgenology in the Mayo Clinic, making and filing of records in the, 372.
Roentgenotherapy, the practical application of the sphere gap to, 195.
Roentgen pictures, pregnancy and labor in, Abstract, 690.
Study of dust inhalation in the granite industry, 244.
Roentgen therapy, Abstract, 45.
A simple device to prevent the omission of filters in deep, 780.
In cancer, personal experience with application of newer, 232.
Deep, in malignant diseases, clinical results from the newer technique of, 236.
Deep, present problems and future prospects of, 276.
Saturation in, its estimation and maintenance, Abstract, 154.
Roentgen-ray cardiac studies, 295.
Diagnosis, developmental rests in cecum and ascending colon and their, 643.
Extra bones in the wrist and ankle found by, 569.
In the diagnosis of sinus disease, Abstract, 89.
On gastric hyperacidity, preliminary report on the effects of, 623.
Pelvimetry by means of the, 272.
Selective organ stimulation by: engine mobilization, 175.
Roentgen-ray study of granite dust inhalation, Dunham's fans in a, 560.
Treatment of acne vulgaris, 468.
Of the eczema group, 520.
Rubin, I. C., Manometer and flow volumeter for transuterine peritoneal inflation to determine patency of fallopian tubes in cases of sterility, 459.
Subphrenic pneumoperitoneum produced by intrauterine insufflation of oxygen as a test of patency of the falliopian tubes in sterility and allied gynecological conditions, 120.

Saelhof, Clarence C., Influence of *x*-ray organ stimulation on the coagulation mechanism, 179.
Selective organ stimulation by roentgen rays: enzyme mobilization, 175.
Sante, L. R., Detection of retroperitoneal masses by the aid of pneumoperitoneum, 129.
Table designed for the simplification of pneumoperitoneum technique, 404.
Sarcoma, primary, of the vertebræ, with report of four cases, 573.
Sciatica, appendicular, a case of, Abstract, 421.
Radiotherapy of, new technique, Abstract, 91.
Schmitz, Henry, Relation of the science of physics to radiation therapy, 285.
Semilunar bone, dislocation of the, 24.
Shoulder, observation on the normally developing, 721.
Sifilide pulmonare, contributa alla conoscenza clinica et radiologica della, Abstract, 420.
Sinuses, head-rest for the roentgenography of accessory, 402.
Sittenfield, M. J., Personal experience with the application of the newer roentgen therapy in cancer, 232.
Skinner, E. H., Congenital atresia of the esophagus, 319.
Collateral treatment of malignant patients undergoing radiotherapy, 138.
Soiland, Albert, Present problems and future prospects of deep roentgen therapy, 276.
Super-radiation and delayed reactions, 466.
Sphere gap, practical application of, to roentgenotherapy, 195.
Sprengel's deformity, the roentgenological aspect of, 654.
Sterility, A manometer and flow-volumeter for trans-uterine peritoneal inflation to determine patency of fallopian tubes in cases of, 459.
Stern, Samuel, Intensive *x*-ray therapy as seen practised in the clinics in Europe, 741.
The value of prophylactic *x*-ray treatment, 199.
X-ray treatment of hypertrophy of the prostate, 292.
Stewart, William H., Roentgenographic studies of bronchiectasis and lung abscess after direct injection of bismuth mixture through the barchoscope, 49.
Stomach, Congenital non-rotation of, 383.
Leather-bottle, (linitis plastica), 163.
Structure of nerve tissue tumors with reference to radium therapy, Abstract, 352.
Studies in reduction of bone density, 355.
Suboccipital Potts disease, 632.
Subphrenic pneumoperitoneum produced by intrauterin insufflation of oxygen as a test of patency of the fallopian tubes in sterility and allied gynecological conditions, 120.
Surgery, radium in the treatment of carcinoma of the breast as an adjunct to, 668.
Surgical physiology and pathology of the colon from the *x*-ray standpoint, Abstract, 552.

Sutherland, C. G., Aneurysm of the aorta and abscess of the tracheobronchial lymph glands, 269.
Swanberg, Harold, Gunshot injuries to the brain, 445.
Syphilis of the lungs, its radiographic findings and their pathological basis, 502.
Syphilitic and tuberculous joints, Abstract, 89.
Symposium on therapy, general discussion following, 279.

Tabetic stomach under *x*-rays, Abstract, 424.
Table designed for simplification of pneumoperitoneum technique, 404.
Therapy, intensive *x*-ray as seen practiced in the clinics in Europe, 741.
The relation of the science of physics to radiation, 285.
Treatment, deep, my studies on the physical foundations of, 578.
Thompson, H. B., Treatment of leukemia, 629.
Thyroid and its diseases, Abstract, 551.
Gland diseases, pathological classification of, with radium treatment in toxic goiter, 755.
New roentgenographic technique for the study of, 81.
Tonsils and adenoids, *x*-ray treatment of, 25.
Tracheobronchial lymph glands, aneurysm of the aorta and abscess of the, 269.
Trahar, F. C., Developmental rests in cecum and ascending colon and their roentgen-ray diagnosis, 643.
Traumatic pneumocranium, 73.
Tuberculosis, the influence of the exposure of the roentgen ray on the progress of tuberculosis, 95.
Pulmonary, *x*-ray treatment of, 241.
Tumors of nerve tissue in relation to treatment by radiation, 497.
Of the lung, the diagnosis of primary, 97.
The treament of, by *x*-ray and radium, Abstract, 208.
Tyler, A. F., Pneumoperitoneum as an aid in the differential diagnosis of diseases of the left half of the abdomen, 65.

Ulcers, benign and malignant gastric from a roentgenologic viewpoint, 695.
Critical review of 500 cases of gastric and duodenal, Abstract, 693.
General and radiologic study of simple duodenal, Abstract, 420.
Studies on gastric and duodenal, Abstract, 692.
Ullmann, H. J., The practical application of the sphere gap to roentgenotherapy, 195.
Upson, W. O., Transposed viscera, 385.
Uterus, radium therapy of cancer of,

Van Allen, H. W., The Bucky diaphragm, 340.
Van Nuys, Roscoe G., Preliminary report on a new tube for producing duodenal block, 779.
Van Zwaluwenburg, James G., Pneumoperitoneum of the pelvis: gynecological studies, 12.
Viscera, transposed, 385.

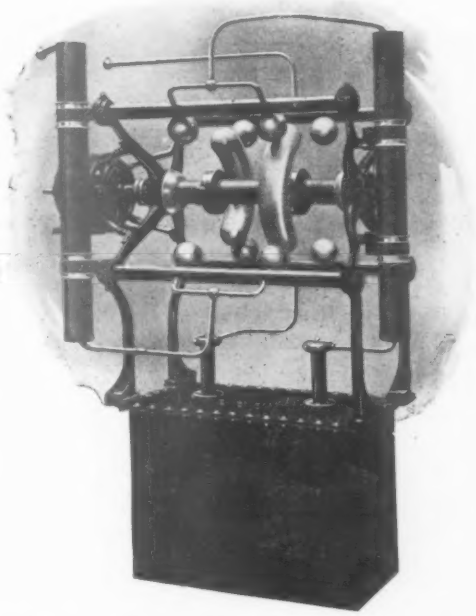
Ware, James G., Hirschsprung's disease, 186.
Washington, Charles A. Pfender, 409.
Watkins, W. Warner, The *x*-ray shadows of lung syphilis and syphilitic-tuberculous symbiosis in the lungs, 259.
Widmann, Bernard Pierre, Multiple osteochondromata, 462.
Wilkinson, Will, *X*-ray treatment of pulmonary tuberculosis, 241.
Williams, John G., Two unusual chest cases, 31.
Wilsey, R. B., The effects of scattered *x*-rays in radiography, 589.
The intensity of scattered *x*-rays in radiography, 328.
Witherbee, William D., *X*-ray treatment of tonsils and adenoids, 25.

X-rays, adhesions in the cecal tract diagnosed by, Abstract, 425.
And radium treatment by, Abstract, 423.
Artificial menopause caused by the, Abstract, 48.
As an essential guide for producing artificial pneumothorax in advanced cases of pulmonary tuberculosis, Abstract, 46.
Burn of third degree followed by rapid healing, 183.
The radical treatment of, Abstract, 93.
Classification of pulmonary tuberculosis and *x*-ray examination of the chest, 427.
Diagnosis of gall-stones in the common duct, Abstract, 619.
Examination of chest and *x*-ray classificattion of pulmonary tuberculosis, 427.
Of duodenal ulcer, Abstract, 619.
Findings in the chronic gas cases, 193.
In carcinoma, The immunizing effects of, Abstract, 424.
In dermatology, 476.
In radiography, the effects of scattered, 589.
The intensity of scattered, 328.
In the diagnosis of tumors of the thorax, Abstract, 550.
Organ stimulation, influence of, on the coagulation mechanism, 179.
Radiation and cancer, Abstract, 423.
Report, 660.
Shadows of lung syphilis and syphilitic-tuberculous symbiosis in the lungs, 259.
Some observations on the treatment of hyperthyroidism with, 730.
Spectra and the structure of matter, 393.
Therapeutics, some remarks on the present status of, 522.
Therapy, intensive, as seen practiced in the clinics in Europe, 741.
The tabetic stomach under, Abstract, 424.
The treatment of carcinoma of the breast by imbedding radium supplemented by, 20.
The use of, as immunity raising agents before and after operation for cancer, 212.
Treatment of hypertrophy of the prostate, 292.
Of pulmonary tuberculosis, 241.
Of tonsils and adenoids, 25.
Of toxic goiter, 635.
The value of prophylactic, 199.
Work from the viewpoint of an internist, 321; editorial, 347.

Young, J. S., *X*-Ray report, 660.

PAUL B. HOEBER, 67-69 East 59th Street, New York

A MARK OF QUALITY A SIGN OF SERVICE



PRECISION X-RAY APPARATUS

THE ONLY X-RAY APPARATUS GIVING

CONSTANT FORM OF RECTIFICATION

CONTINUOUS, ACCURATE AND DIRECT MEASUREMENTS OF SECONDAY POTENTIAL

RECTIFICATION OF HIGH TENSION CURRENT WITHOUT PRODUCING CORONA

The Distinctive Apparatus with Exclusive Qualities, Efficient Design and one which can be built for any capacity.

The only Apparatus with a Crest Kilovolt Meter giving accurate and direct Readings of the High Tension voltage across the tube terminals during the operation of the X-Ray Tube.

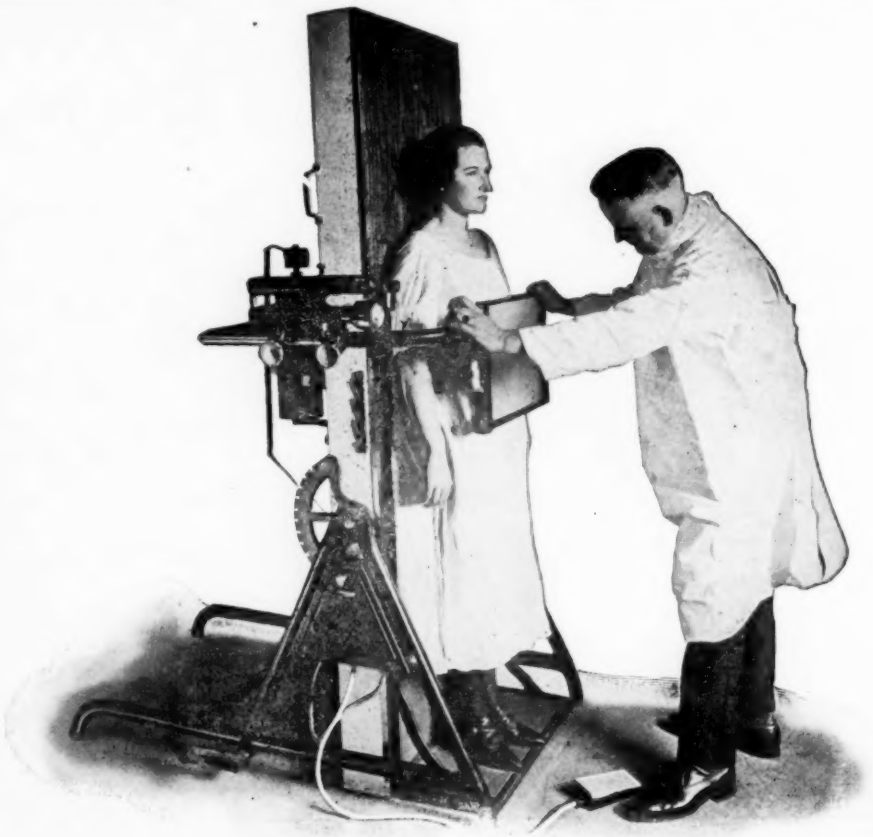
During the Twenty-Second Annual Convention of The American Roentgen Ray Society in Washington, September 27th to 30th inclusive, the exhibit of INTERNATIONAL products created greater enthusiasm and received more favorable comment than has ever been expressed at other exhibits of X-Ray apparatus.

The Rectifying Unit, only, is illustrated herewith and we invite you to write for full explanation and illustrations of complete machine.

INTERNATIONAL X-RAY CORPORATION

326 BROADWAY NEW YORK CITY

Sales Distributors conveniently located and capable of rendering the best of service



THE RIEBER FLUOROSCOPIC UNIT

Ready for Action

A Combination X-Ray Machine and Fluoroscopic Apparatus in one unit.
Uses Coolidge Tube. - No overhead wires or troublesome cord reels.
No special wiring necessary. - Operation Learned In An Hour.

THE ROENTGEN APPLIANCE COMPANY

SAN FRANCISCO, CALIFORNIA

DISTRIBUTORS

GENERAL X-RAY CO., Boston, New York
R. L. SCHERER CO., Los Angeles
SHAW SUPPLY CO., Tacoma, Seattle, Portland
WALLERSTEDT & PAUL, San Francisco

General Office San Francisco, California
Boston, New York, Tacoma, Seattle, Portland, San Francisco, Los Angeles, New Orleans, Fort Worth

THE PATTERSON CLEANABLE INTENSIFYING SCREEN

THIS SCREEN IS MORE THAN THE NAME IMPLIES, FOR BESIDES BEING REALLY CLEANABLE THE BIG FEATURE OF THE SCREEN IS THAT IT RESISTS AND IS PRACTICALLY IMPERVIOUS TO DIRT.

THE "PATTERSON CLEANABLE" INTENSIFYING SCREEN REPRESENTS TRUE PATTERSON QUALITY—AND PATTERSON QUALITY CAN BE VOUCHED FOR BY THOUSANDS OF USERS BOTH HERE AND ABROAD.

THE TWO OUTSTANDING ADVANTAGES OF THE NEW SCREEN ARE ECONOMY AND RESULTS. ECONOMY BECAUSE OF THE LIFE OF THE SCREEN: RESULTS BECAUSE YOU WILL HAVE NEGATIVES THAT WILL BE FREE OF THE SPOTS AND EARMARKS THAT ARE ALWAYS PRESENT IN UNPROTECTED SCREENS AFTER THEY HAVE BEEN IN USE FOR A WHILE.

THE "PATTERSON CLEANABLE" MAY BE USED AS AN UPPER OR A LOWER SCREEN IN DOULE SCREEN TECHNIQUE, THAT IS, FOR DOUBLE SCREEN TECHNIQUE USE TWO PATTERSON CLEANABLES.

WE ARE STILL MAKING THE PATTERSON "STANDARD" AND "SPECIAL" INTENSIFYING SCREEN AND IF DESIRED CAN BE OBTAINED THROUGH YOUR DEALER.

ASK YOUR DEALER ABOUT THE NEW "PATTERSON CLEANABLE."

THE SIGN OF QUALITY

THE PATTERSON SCREEN COMPANY

TOWANDA, PENNSYLVANIA, U. S. A.

PLAIN RADIOGRAPHIC TABLE

Constructed entirely of wood, Mahogany Piano Finish. Legs detachable for shipping purposes.

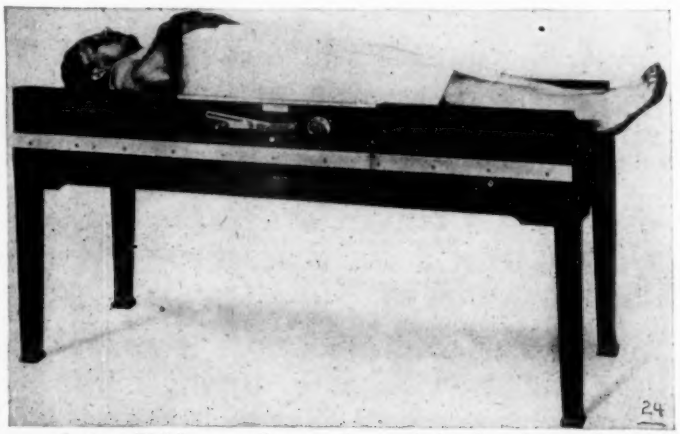
Table top is made of five plys selected woods so as to give total absence from wood graining when viewed fluoroscopically, and blocks off only as much X-Ray as would 1 MM of aluminum.

With suitable tube stand and high tension spacers, so the ray can be directed upwards from underneath table, it can be used for limited horizontal fluoroscopy as well as radiographic work. In many X-ray laboratories there is not sufficient use for horizontal fluoroscopy to justify the investment in a more expensive regular table especially equipped for horizontal fluoroscopy. In such instances, in addition to serving its purpose as a plain radiographic table, this table answers very satisfactorily for such limited horizontal fluoroscopy as is encountered.

This piece of apparatus is also finding wide application as a deep therapy table on account of the absence of metal in its construction, excellent insulating qualities, fine finish and reasonable price.

Price, fob Cincinnati - - - - - - - - $48.00

COMBINED PLAIN RADIOGRAPHIC & BUCKY TABLE



Same as our plain radiographic table, with the addition of steel runners and nickel plated end guide strips so that Bucky Diaphragm can be moved easily to middle or either end of table. This is adapted to the Brady, Engeln or Victor Diaphragms. Specify which when ordering. Table can of course be used also for plain radiographic work or horizontal fluoroscopy, by sliding the Bucky to one end or removing it entirely.

Price, complete, fob Cincinnati - - - - - - $60.00

Bucky Blocks, constructed of wood, same size and shape as Bucky, finish matching with table. Top of blocks is curved to same radius as top of Bucky, so that patient is comfortable during exposure, and easily positioned. They also slide readily to any part of table.

Price, set of two, complete, fob Cincinnati - - - - $18.00

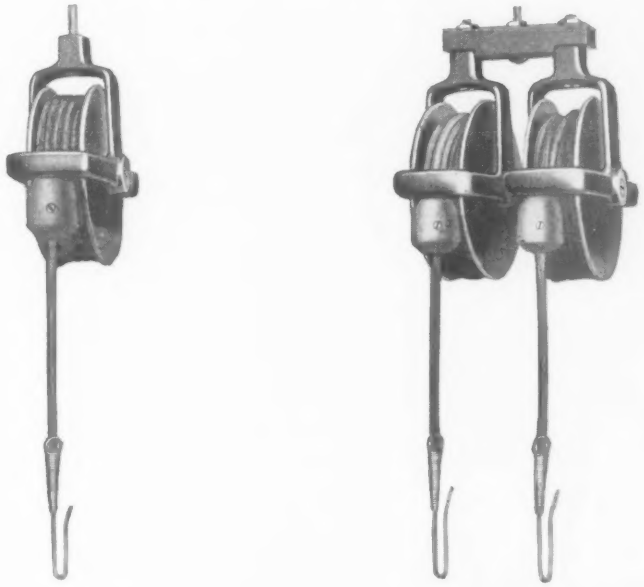
Combination, consisting of Table and Blocks, if ordered together at same time.

Special price, fob Cincinnati - - $75.00 Table Top - - $30.00

LIEBEL-FLARSHEIM COMPANY

41 HOME STREET CINCINNATI, OHIO

TROUBLE SAVERS



THE ENGELN AUTOMATIC REELS

We all have unlucky days—is some of your trouble caused by inefficient reels? These New Reels will eliminate trouble—

BECAUSE the 14 guage reel cord is large and cuts out the unnecessary resistance in your Coolidge circuit—the cords can be extended from ANY position without cutting, binding or wearing the cord.

The adjustable rubber stop keeps the cord within your reach. The reels are CORONALESS—you know this advantage. They have a black-satin finish and are wound with 10 feet of cord.

$5.50 for the Single Reel and $11.50 for the Double Reel. They are ready for immediate delivery—let us fill your order at once.

THE ENGELN ELECTRIC COMPANY

4601-11 Euclid Avenue, CLEVELAND, OHIO

BRANCHES:

NEW YORK PHILADELPHIA PITTSBURGH TORONTO CHICAGO
PORTLAND, ORE. DETROIT CINCINNATI LOS ANGELES

VEIFA APPARATUS & VEIFA SERVICE FOR THE U. S. A.

Deep therapy X-Ray apparatus and accessories

(*Prices quoted include all duty, transportation and installation charges*)

— SERVICE BY COMPETENT ENGINEERS —

INTENSIV-REFORM-APPARATUS - - - 200,000 Volts
(System DESSAUER)

NEO-INTENSIV-REFORM-APPARATUS - 300,000 Volts
(System DESSAUER)

IONTOQUANTIMETER AND ELECTROSCOPE for determining quality and quantity of X-Rays

CLINOSCOPE for fluoroscopy and radiography

The DEEP THERAPY MACHINES of which OVER 300 are installed in Europe (many of them operating 6-10 hours daily for 4 years), are guaranteed against breakdowns and are completely equipped to operate two tubes simultaneously.

(*For picture of apparatus see* THE AMERICAN JOURNAL OF ROENTGENOLOGY, VOL. VIII, *page* 587)

Correspondence solicited

KURT STOYE, *Manager*

Temporary address: 52 VANDERBILT AVE. - NEW YORK CITY

A MOBILE UNIT FOR THERAPY AND RADIOGRAPHY

This is the "INTERMEDIATE UNIT"

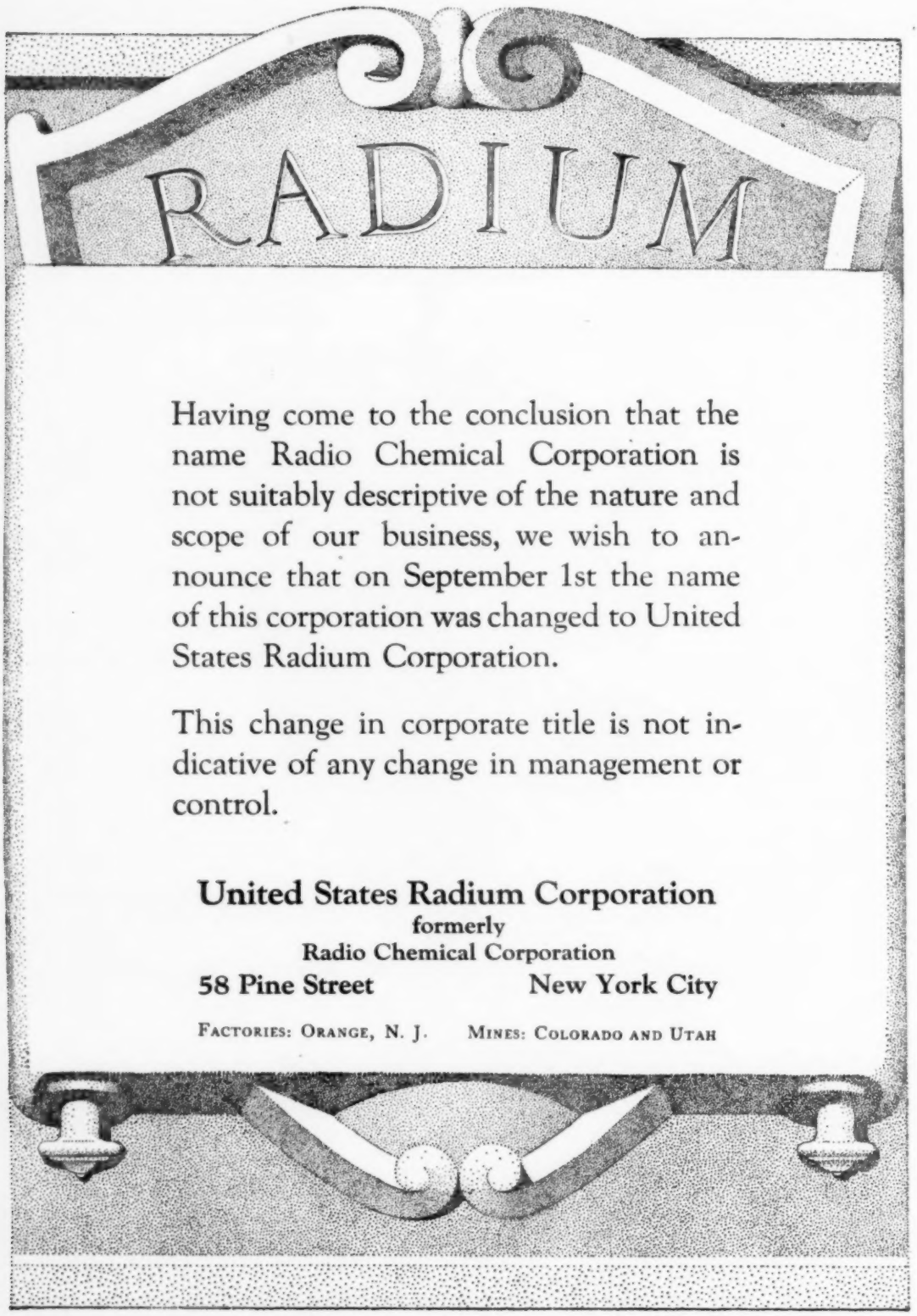
RADIOGRAPHY—0" - 6" Gap 0 to 40 ma.
RADIOTHERAPY—4" - 9" Gap 2 to 5 ma.

Write us regarding this and our
20 INCH DEEP THERAPY MACHINE

THE HIGH TENSION TRANSFORMER & EQUIPMENT CO.

Factory
HOBOKEN, N. J.

Sales Office
212 EAST 23RD ST., N. Y. C.


RADIUM
Having come to the conclusion that the name Radio Chemical Corporation is not suitably descriptive of the nature and scope of our business, we wish to announce that on September 1st the name of this corporation was changed to United States Radium Corporation.
This change in corporate title is not indicative of any change in management or control.
United States Radium Corporation
formerly
Radio Chemical Corporation
58 Pine Street New York City
FACTORIES: ORANGE, N. J. MINES: COLORADO AND UTAH

In Answering Advertisements please mention The American Journal of Roentgenology.

Ready in January

[ANNALS OF ROENTGENOLOGY, VOLUME II.]

THE PATHOLOGICAL GALL-BLADDER

ROENTGENOLOGICALLY CONSIDERED

BY

ARIAL W. GEORGE, M.D. AND RALPH D. LEONARD, M.D.

DR. GEORGE'S gall-bladder work has long been a subject of discussion among roentgenologists and medical men generally. The demand has been great for a complete monograph describing in detail the technique used and the logical sequence of the details leading to the splendid diagnostic results achieved.

The editor and the publisher feel an especial pride therefore in being able to present to the profession as the second volume of the ANNALS OF ROENTGENOLOGY this complete work by DRS. A. W. GEORGE and R. D. LEONARD.

All details are given concisely and clearly so that the experienced roentgenologist has a complete work of reference at his disposal, and the veriest tyro has a textbook which if followed to the letter will produce results he cannot otherwise achieve. Those interested only from the medical and surgical point of view will find this monograph and atlas of great aid in the interpretation of plates.

The arrangement is as follows: I. Pathological Gall-Bladders containing Gall-Stones. II. The Visible Pathological Gall-Bladder. III. The Pathological Gall-Bladder: Indirect Evidence. Under each of these sections illustrative cuts are used covering the average, and at the same time the variety of conditions met with in the study of the biliary tract.

The captions of the illustrations and the introductory text of each division are printed in English, French and Spanish.

UNIFORM IN FORMAT WITH LAW—"MASTOIDS"

One hundred and thirty-five roentgen ray studies on forty-four full page plates, of which three are actual photographs, and two text illustrations.

PRICE (*Postpaid*) $10.00 *Net*

Published by PAUL B. HOEBER

67-69 EAST 59TH STREET NEW YORK CITY

THE AMERICAN JOURNAL OF ROENTGENOLOGY
GENERAL INFORMATION

Original articles are published only with the understanding that they are contributed exclusively to this journal. Manuscripts offered for publication and other correspondence relating to the editorial management and books for review should be sent to Dr. H. M. Imboden, Editor, 480 Park Avenue, New York, N. Y. Contributions may be sent in foreign languages and will be translated if found acceptable.

A certain number of illustrations will be supplied free of cost; but special arrangements must be made with the editor and publisher for excess illustrations and elaborate tables. Drawings and charts for reproduction should be made in black (*never* in blue) when intended for reproduction. Photographic prints of plates or slides on glossy paper produce the best half-tones.

Manuscripts should be type-written, in double spacing, with good margins (not on thin paper) and the original sent us; it is a good plan for the author to keep a carbon copy, as used manuscripts are not returned. All photographs and drawings should be numbered, and accompanied by legends with corresponding numbers. The top should be indicated on the photograph.

The author should always place his *full address* somewhere on his manuscript. This is very important, and is often omitted.

Reprints are furnished on order only and should be ordered of the publisher when galley proofs are submitted. Prices will be quoted on request.

All correspondence regarding subscriptions, advertisements and other buisness of THE AMERICAN JOURNAL OF ROENTGENOLOGY should be addressed to the Publisher, Paul B. Hoeber, 67-69 East 59th Street, New York.

For information about membership in THE AMERICAN ROENTGEN RAY SOCIETY address the Chairman of the Executive Committee, Dr. H. K. Pancoast, University Hospital, Philadelphia, Pa.

For information regarding program of annual meeting, address the President, Dr. A. C. Christie, 1621 Connecticut Ave., Washington, D. C.

Requests for information regarding exhibits at annual and section meetings and business matters in connection with these meetings should be addressed to the Business Manager, Paul B. Hoeber, 67-69 East 59th Street, New York.

In sending change of address, give the old as well as the new, stating which is which, and whether the new address is temporary or permanent.

In corresponding with the publisher about more than one subject, reprints, subscriptions, meetings, etc., please put each item on a separate sheet. Please make all communications containing orders, requests, information or directions specific and unmistakably clear.

ACTA RADIOLOGICA

PUBLISHED BY THE SOCIETIES FOR MEDICAL RADIOLOGY IN DENMARK, FINLAND, NORWAY AND SWEDEN

Presents the results of researches in these countries within the fields of *roentgendiagnostics, radiotherapy, heliotherapy and medical electricity*. The articles in this journal are published in the English, French or German language, according to the decision of the author.

ACTA RADIOLOGICA is published in richly illustrated volumes of about 500 pages, distributed in four occasional numbers. Price $6.00 per vol.

Subscriptions may be forwarded to

The Chief Editor, Bergsgatan 2, Stockholm, Sweden

or to the agent for the United States

Paul B. Hoeber, 67-69 East 59th Street, New York City

Editorial staff:

JOH. FRED. FISCHER, Copenhagen — GOSTA FORSSELL, Stockholm — S. A. HEYERDAHL, Christiania — G. A. WETTERSTRAND, Helsingfors

Chief Editor: GOSTA FORSSELL, M.D., Professor at the Royal Caroline Institute, Stockholm, Sweden

THE AMERICAN ROENTGEN RAY SOCIETY
AND THE AMERICAN RADIUM SOCIETY
Officers and Standing Committees

THE AMERICAN ROENTGEN RAY SOCIETY

President
ARTHUR C. CHRISTIE, M.D., 1621 Connecticut Ave., Washington, D. C.

President-Elect
W. H. STEWART, M.D., 222 West 79th St., New York

Vice-President
A. W. GEORGE, 43 Bay State Road, Boston

Second Vice-President
W. W. WATKINS, M.D., Phoenix, Ariz.

Secretary
H. E. POTTER, M.D., 122 S. Michigan Ave. Chicago

Treasurer
W. A. EVANS, M.D., 32 Adams Ave., W., Detroit

Librarian and Historian
H. W. DACHTLER, 224 Michigan St., Toledo, O.

Executive Committee
ALEXANDER B. MOORE, M.D., Chairman
Rochester, Minn.
W. D. BOWMAN. M.D., Los Angeles, Calif.
W. F. MANGES, M.D., Philadelphia, Pa.

Safety Committee
JOHN S. SHEARER, Ithaca, N. Y.
P. M. HICKEY, M.D., Detroit, Mich.
W. D. COOLIDGE, M.D., Schenectady, N. Y.
G. W. HOLMES, M.D., Boston, Mass.
H. K. PANCOAST, M.D., Philadelphia, Pa.

Committee on Laws and Public Policy
E. H. SKINNER, M.D., Kansas City, Mo.
CHARLES F. BOWEN, M.D., Columbus, O.
E. A. MERRITT, M.D., Washington, D.C.

Publication Committee
W. F. MANGES, M.D., Philadelphia, Pa.
ARTHUR C. CHRISTIE, M.D., Washington, D.C.
H. E. POTTER, M.D., Chicago, Ill.

Editor
H. M. IMBODEN, M.D., 480 Park Ave., New York

Associate Editor
PERCY BROWN, M.D., Boston, Mass.

Publisher and Business Manager
PAUL B. HOEBER, 67-69 East 59th St., New York City

SECTIONS OF THE AMERICAN ROENTGEN RAY SOCIETY

EASTERN SECTION

President
J. M. STEINER, M.D.
103 Park Ave., New York City

Vice-President
H. M. IMBODEN, M.D.,
New York City

Secretary
CHARLES A. WATERS, M.D.
Baltimore, Md.

THIRD
ANNUAL MEETING
Atlantic City, Jan. 26, 27, 28, 1922
(Headquarters, Ritz-Carlton Hotel)

CENTRAL SECTION

President
WILLIAM M. DOUGHTY, M.D.,
628 Elm St., Cincinnati, Ohio

First Vice-President
D. Y. KEITH, M.D., Louisville, Ky.

Second Vice-President
E. S. BLAINE, M.D., Chicago, Ill.

Secretary-Treasurer
A. F. TYLER, M.D., Omaha, Neb.

THIRD ANNUAL MEETING
Chicago, February—, 1922

PACIFIC SECTION

President
ALBERT B. SOILAND, M.D.,
527 W. 7th St., Los Angeles

Vice-President
HOWARD E. RUGGLES, M.D.,
San Francisco, Calif.

Secretary
W. WARNER WATKINS, M.D.
Pheonix, Ariz.

THIRD
ANNUAL MEETING
(To be announced)

THE AMERICAN RADIUM SOCIETY

President
GEORGE E. PFAHLER, M.D., 1321 Spruce St., Philadelphia, Pa.

First Vice-President
LEDA J. STACY, M.D., Rochester, Minn.

Second Vice-President
CURTIS F. BURNHAM, M.D., Baltimore, Md..

Secretary
WILLIAM S. NEWCOMET, M.D., 3501 Baring St.,
Philadelphia, Pa.

Treasurer
R. E. LOUCKS, M.D., David Whitney Bldg., Detroit, Mich.

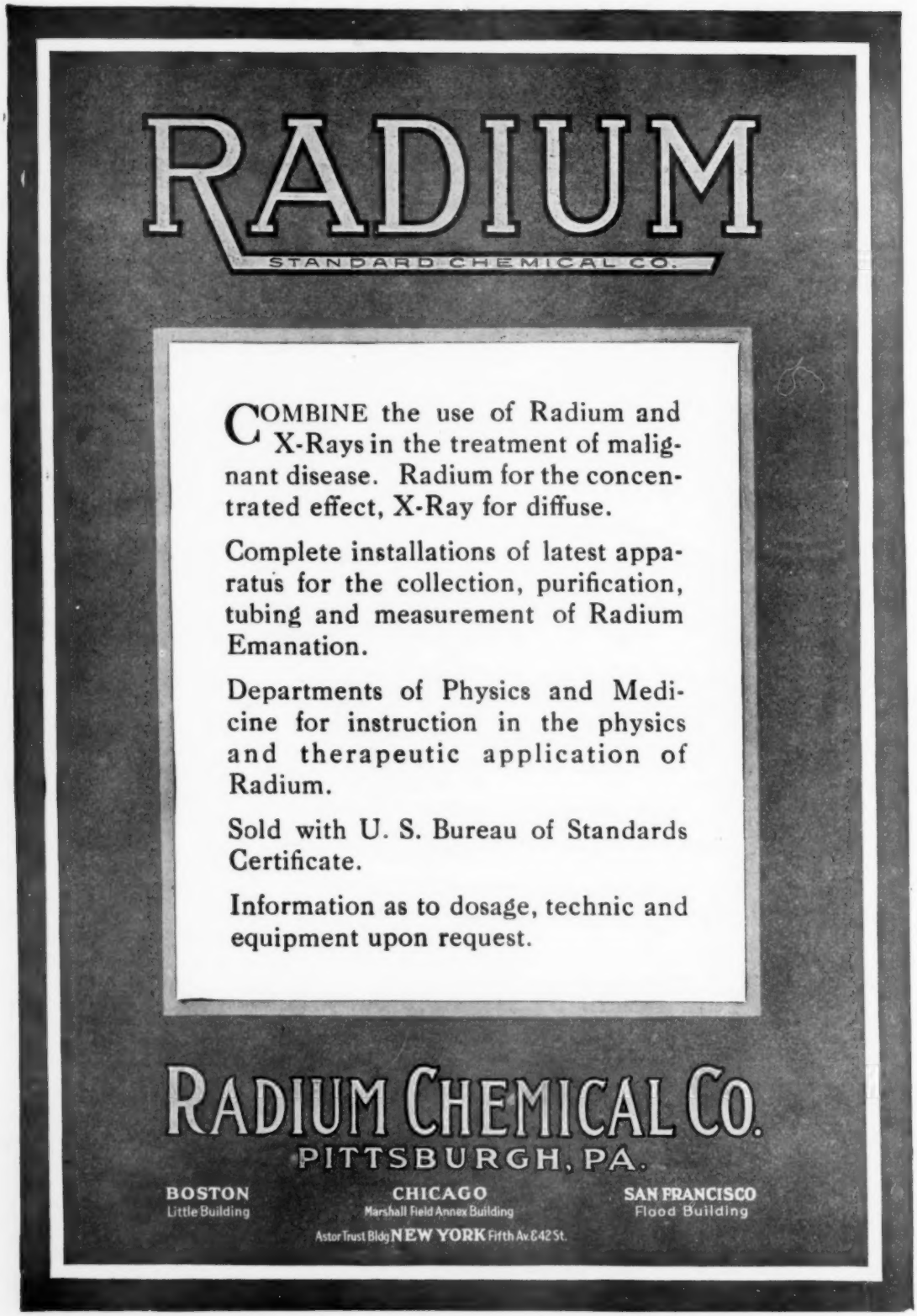
Executive Committee
JOHN G. CLARK, M.D., Chairman, Philadelphia, Pa.
HENRY K. PANCOAST, M.D., Philadelphia, Pa.
HENRY SCHMITZ, M.D., Chicago, Ill.

Membership Committee
R. E. LOUCKS, M.D., Chairman, Detroit, Mich.
JAMES T. CASE, M.D., Battle Creek, Mich.
DOUGLAS QUICK, M.D., New York City

Program Committee
HENRY K. PANCOAST, M.D., Chairman, Philadelphia.
HENRY SCHMITZ, M.D., Chicago, Ill.
GIOACCHINO FAILLA, E.E., New York City

Local Committee of Arrangements
EDWIN C. ERNST, M.D., Chairman, St. Louis, Mo.
SANFORD MARTIN WITHERS, M.D., St. Louis, Mo.

SEVENTH ANNUAL MEETING
St. Louis, Missouri, May 22, 23, 1922.


RADIUM
STANDARD CHEMICAL CO.
COMBINE the use of Radium and X-Rays in the treatment of malignant disease. Radium for the concentrated effect, X-Ray for diffuse.
Complete installations of latest apparatus for the collection, purification, tubing and measurement of Radium Emanation.
Departments of Physics and Medicine for instruction in the physics and therapeutic application of Radium.
Sold with U. S. Bureau of Standards Certificate.
Information as to dosage, technic and equipment upon request.
RADIUM CHEMICAL CO.
PITTSBURGH, PA.
BOSTON
Little Building
CHICAGO
Marshall Field Annex Building
SAN FRANCISCO
Flood Building
Astor Trust Bldg NEW YORK Fifth Av. & 42 St.

THE AMERICAN JOURNAL OF ROENTGENOLOGY

[FOUNDED IN 1906 AS THE AMERICAN QUARTERLY OF ROENTGENOLOGY]
OFFICIAL ORGAN OF
THE AMERICAN ROENTGEN RAY SOCIETY
AND THE AMERICAN RADIUM SOCIETY

VOL. VIII (NEW SERIES) DECEMBER, 1921 NO. 12

CONTENTS

		PAGE
Benign and Malignant Gastric Ulcers from a Roentgenologic Viewpoint	BY RUSSELL D. CARMAN, M.D.	695
Roentgenological Studies of Infected Kidneys	BY W. K. LIM, M.D.	704
A Review of Three Years' Work and Articles on Pneumoperitoneum	BY JAMES T. CASE, M.D.	714
Observations on the Normally Developing Shoulder	BY ISIDORE COHN, M.D.	721
Some Observations on the Treatment of Hyperthyroidism with X-Rays	BY GEORGE W. HOLMES, M.D.	730
Intensive X-Ray Therapy as seen Practiced in the Clinics in Europe	BY SAMUEL STERN, M.D.	741
The Treatment of Cancer of the Rectum by Radium	BY DOUGLAS QUICK, M.D.	746
Pathological Classification of Thyroid Gland Diseases with Radium Treatment in Toxic Goiter	BY R. E. LOUCKS, M.D.	755
American Literature on Radium and Radium Therapy Prior to 1906	BY CARROLL M. CHASE, M.D.	766
Preliminary Report on a New Tube for Producing Duodenal Block	BY R. G. VAN NUYS, M.D.	779
A Simple Device to Prevent the Omission of Filters in Deep Roentgen Therapy	BY G. E. PFAHLER, M.D.	780
Editorials		781
Radiodermatitis	BY G. E. PFAHLER, M.D.	
Book Reviews		786

The American Journal of Roentgenology is maintained by, and in the interests of The American Roentgen Ray Society, and published monthly by Paul B. Hoeber, 67-69 East 59th Street, New York, N. Y.

Original articles are published only with the understanding that they are contributed exclusively to this journal. Manuscripts offered for publication and other correspondence relating to the editorial management and books for review should be sent to Dr. H. M. Imboden, 480 Park Avenue, New York, N. Y.

The American Journal of Roentgenology does not hold itself responsible for any statements made or opinions expressed by any contributor in any article published in its columns.

Communications regarding business of The American Roentgen Ray Society, including applications for membership, should be addressed to the Chairman of the Executive Committee, Dr. Henry K. Pancoast, University Hospital, Philadelphia, Pennsylvania.

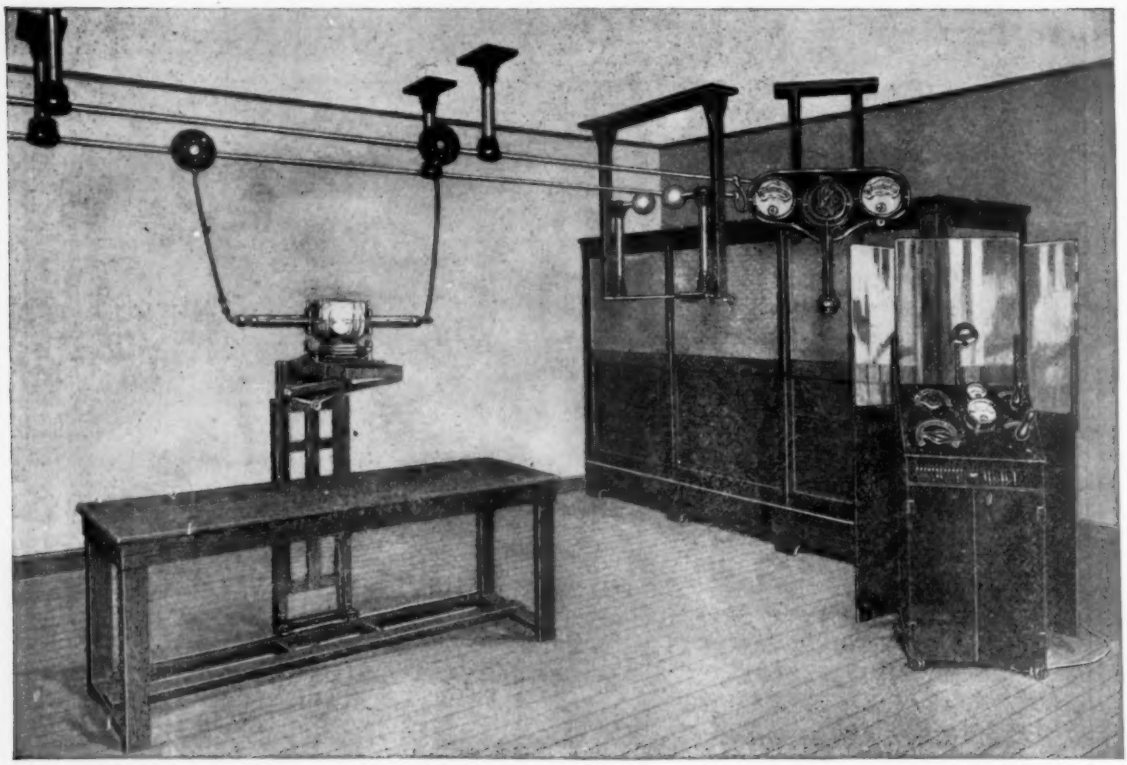
Communications regarding subscriptions, advertisements, reprints, etc., should be addressed to the Publisher, Paul B. Hoeber, 67-69 East 59th Street, New York, N. Y.

The subscription price of The American Journal of Roentgenology is $6.00 per year, in advance, in the United States, $6.50 in Canada and $7.00 in other foreign countries. Current single numbers, $1.00. Prices for back numbers will be quoted on request.

Entered as second-class matter, March 3, 1916, at the Post Office, New York. N. Y., under the Act of March 3, 1879.

Copyright, 1921, by Paul B. Hoeber.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorised August 5, 1919.



Victor Deep Therapy Roentgen Apparatus

Each unit of this complete equipment is designed especially to meet the requirements for the new Deep Therapy technique. It is an extension of the present Victor standard of design along the line of principle established by our past practice and experience, backed up by unequalled facilities for research and experimental work. Thus is insured apparatus of reliability and practical usefulness.

We are now filling orders for this apparatus. Consists of the following:

High Voltage Transformer capable of producing 280,000 volts (equivalent of a 20" back-up spark between points), using the famous "Snook" cross-arm type rectifying switch, the most reliable and efficient method in existence for rectifying high voltages. Cabinet for Transformer has removable panels on two sides for easy access to transformer and rectifying switch.

Control Stand of similar design to the one used with Victor Model "Snook" Roentgen Apparatus, and includes Motor switch, X-ray switch, polarity indicator, primary voltmeter, Coolidge Filament control and "grid" type resistance.

Deep Therapy Table of special design, all wood construction, with means of adjustment for every required position and calibrated scales for each.

Victor-Kearsley Stabilizer, suspended from ceiling with two milliampere meters in series, serving as a double check on tube current. The necessity of the stabilizer in all treatment work is well known, insuring as it does a constant tube current in spite of line fluctuations at the Coolidge Filament Transformer and the X-Ray Transformer.

Corona-Proof Overhead System especially designed for this Outfit.

Victor Sphere Gap, the most practical means of reading exact voltage used in treatments.

Price on complete apparatus, as above illustrated and described, $8000.00

VICTOR X-RAY CORPORATION, Jackson Blvd. at Robey St., Chicago

Sales Offices and Service Stations in All Principal Cities

VICTOR

RADIUM IS WORTH ITS COST

Radium has a definite place in surgery and medicine to-day in the specific treatment of skin and other superficial forms of cancer, and also in conjunction with the operative treatment of cancer occurring internally. Its value in the treatment of some other common diseases has been demonstrated and proven.

MEDICAL RESEARCH SERVICE

It is the purpose of the Radium Company of Colorado to co-operate with not only those physicians who have bought radium, but also with those who would like to keep abreast of the current developments of the treatment of disease with this unique therapeutic element.

A PHYSICIAN'S REPUTATION

will be, not only safe-guarded but enhanced, if when entering upon the practice of radium therapy he has at his command the complete and careful service which the mark below denotes.

Write our nearest office.

We can explain more intelligently this Company's complete service which only commences when the purchase of radium is made, if when writing us the physician or surgeon states in what field of work he is specializing.

The Mark of a Complete and Careful Radium Therapeutic Service

THE RADIUM COMPANY OF COLORADO

PRINCIPAL OFFICES - LABORATORIES

RADIUM BUILDING DENVER, COLORADO

BRANCH OFFICES

SAN FRANCISCO
582 MARKET ST.

CHICAGO
PEOPLES GAS BLDG.

NEW YORK
50 UNION SQUARE

KRONENBERG

THIS SHIELD YOUR PROTECTION

KRONOL PREPARED DEVELOPER

SUCCESS IN ROENTGENOLOGY DEPENDS ON SEVERAL FACTORS:—

1. Efficiency of X-Ray Machine.
2. Correct technique of the operator in regulating the tube, etc.
3. Quality of the plate or film.

The result of all these factors combined is either MADE *or* MARRED *by*—

4. THE DEVELOPER.

To get uniformly good results it is of the utmost importance to use a developer that is dependable and constant in its action.

KRONOL PREPARED DEVELOPER BRINGS OUT SHARPEST CONTRASTS, GREATEST BRILLIANCY AND RICH, CLEAR DETAILS IN EITHER PLATES OR FILMS.

It is put up in powder form and will keep indefinitely in any climate.

Quart size (No. 1) $ .40 per package
Gallon size (No. 2) $1.10 per package

KRONOL PREPARED DEVELOPER IS ALWAYS READY—JUST DISSOLVE IN WATER AND USE.

KRONENBERG X-RAY & SUPPLY CO.
MANUFACTURERS - IMPORTERS - DISTRIBUTORS
527 N. HOWARD STREET
BALTIMORE, MD.

BRANCHES:
WASHINGTON, D. C.
PITTSBURGH, PA.
RICHMOND, VA.
CHARLOTTE, N. C.

Mail this coupon for special introductory offer.
Name .....
Street .....
City .....
State .....
Capacity of my developing tank .....
A.J.of R.

The Premier AMERICAN Screen

ROENTGEN INTENSIFYING SCREEN
T-E
MADE IN U.S.A.

Dr. H. Threlkeld-Edwards
SOUTH BETHLEHEM, PA.

"Made by a Roentgenologist for Roentgenologists"

The "T-E" X-Ray Screen was produced in 1910 by an AMERICAN ROENTGENOLOGIST for personal use in his Laboratory, because Foreign Screens had proved inadequate and unsatisfactory.

For more than ten years "T-E" Screens have been the choice of AMERICAN ROENTGENOLOGISTS.

In mathematical terms "T-E" Screens have always been

+ SPEED — GRAIN

The "T-E" Unit for use with Dupli-tized Films.

H. THRELKELD EDWARDS, M.D.
X-RAY LABORATORY, SOUTH BETHLEHEM, PA., U. S. A.

STOP

HAS IT EVER OCCURRED TO YOU HOW FREQUENTLY A PERSON WHEN PURCHASING A PIECE OF APPARATUS OVERLOOKS THE MOST IMPORTANT DETAIL?

THE FLUOROSCOPIC SCREEN IS THE MOST IMPORTANT DETAIL OF A FLUOROSCOPE, FOR WITHOUT IT THE APPARATUS IS OF NO USE.

THE FLUOROSCOPIC SCREEN SHOULD BE PERMANENT, AND MUST NOT DETERIORATE UNDER ANY OF THE CONDITIONS IMPOSED UPON IT: BRILLIANT AND GRAINLESS, GIVING A CLEAR UNIFORM LIGHT; AND WITHOUT PHOSPHORESCENT AFTERGLOW.

PATTERSON FLUOROSCOPIC SCREENS HAVE ALL OF THESE ATTRIBUTES. SPECIFY PATTERSON.

FOR SALE BY YOUR DEALER

X-RAY
FLUOROSCOPIC SCREEN
THE PATTERSON SCREEN CO
TOWANDA PA U.S.A.

THE SIGN OF QUALITY

THE PATTERSON SCREEN COMPANY

TOWANDA, PENNSYLVANIA, U. S. A.

The Element of Safety in X-Ray Work

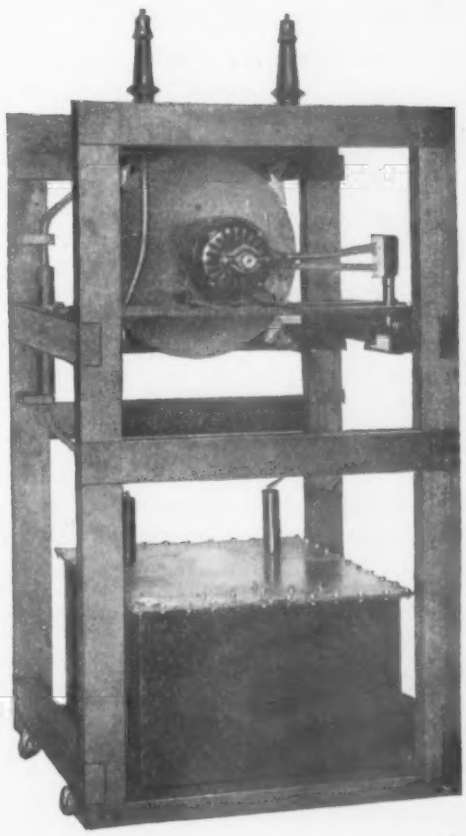
is increased to a marked extent by the use of the *patented safety device* which is incorporated into every

SUPER-STANDARD
X-RAY TRANSFORMER

Every radiologist owes it to himself to learn about this excellent feature—to-day.

A new complete catalog is ready.
Reserve your copy to-day!

STANDARD X-RAY CO.
1932 No. Burling St. Chicago



"SWEETBRIAR SCREENS ARE ABSOLUTELY GRAINLESS"

DO YOU KNOW

THAT SWEETBRIAR SCREENS CAN BE WASHED?

Of course your intensifying screens get soiled—that is unavoidable—and then the quality of your negatives suffers. But if your screens are SWEETBRIARS, a little dirt is a small matter, for with warm, soapy water and a soft cloth it can be removed, the screens can be wiped with a clean, soft cloth, and they will be as good as new. And the best of it is that the process can be repeated over and over again, for the longer you use SWEETBRIAR SCREENS, the harder they become and the more easily they can be washed.

This quality in SWEETBRIAR SCREENS is not due to a coating on the surface, but to the composition of the fluorescent coating, and the screen is therefore not slowed by reason of being washable.

PLEASE NOTE that the prices charged for the *grainless, washable* SWEETBRIAR SCREENS are no higher than the usual standard prices on screens.

* * * * * * *

The enlarged manufacturing facilities for which we made arrangements last summer in our present laboratories have proved entirely inadequate for the volume of business which has come to us, and we have been forced to purchase another plant large enough to admit of necessary expansion.

After December 1st, our address will be

SWEETBRIAR LABORATORIES, Inc.

1220-1228 HODGKISS ST., N. S. PITTSBURGH, PA.

ANNOUNCEMENT

THE KELLEY-KOETT 280,000 VOLT TRANSFORMER

NOW READY

Have a machine which performs the work of two.

Treat two patients at one time.

Compact assembly. - Maximum floor space 6 ft. x 8 ft.

Delivery eight weeks. - Price f.o.b. Covington $4500.00.

VALUABLE ACCESSORY

Magnetic Devices for Stereoscopic Shift of Kelley-Koett No. 6 Stand and Erect Stereo Plate Shifter.

Invaluable for instantaneous

STEREOSCOPIC CHEST WORK

Price $45.00 for both.

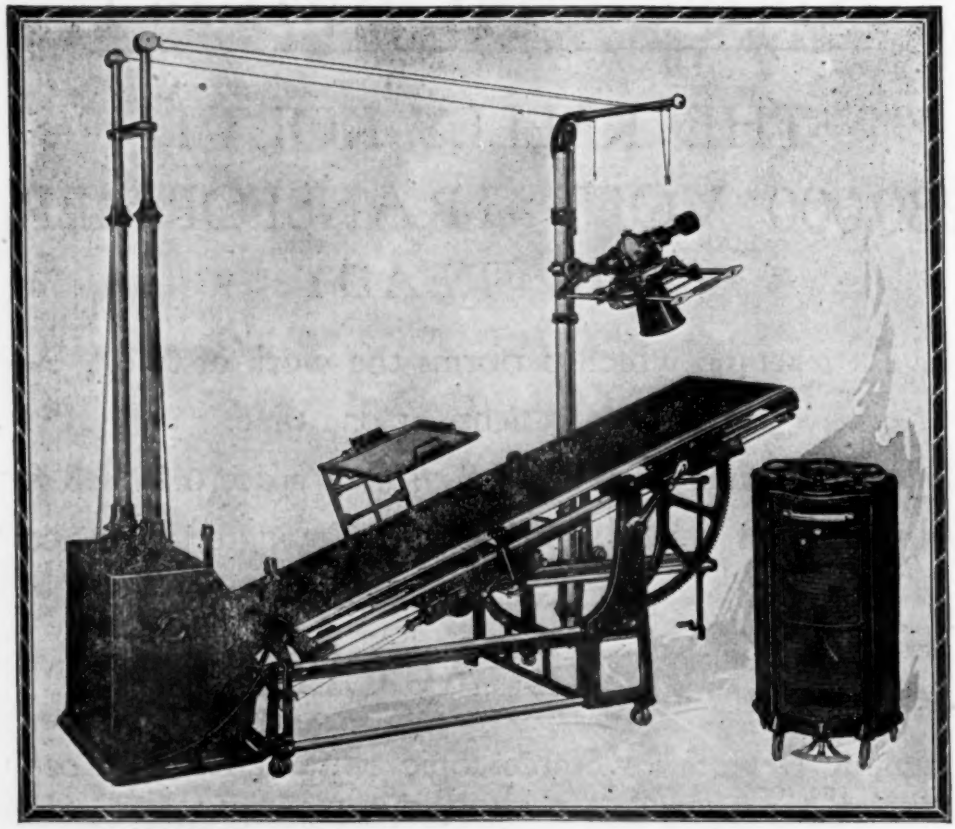
K. & B. ELECTRICAL EQUIPMENT CO.
INCORPORATED

127 EAST 23RD STREET, NEW YORK, N. Y.

BUFFALO, N. Y.
19 ALLEN ST.

BOSTON
177 NEWBURY ST.

THE ACME X-RAY UNIT



THE ACME X-RAY UNIT as shown in the illustration, consists of:

1—RADIOGRAPHIC AND FLUOROSCOPIC TABLE for radiographic, stereoscopic and fluoroscopic work in any position or angle from the Trendelenburg to the vertical.

2—TUBE STAND with friction joints substituted for all hand or lock screws.

3—TUBE HOLDER underneath complete with FLUOROSCOPIC SHUTTER and control for all forms of fluoroscopic work.

4—COMBINATION HEAD AND SHOULDER REST AND SEAT which can be instantly attached to any desired position on the table top.

5—FLUOROSCOPIC SCREEN HOLDER adjusted by friction joints to every possible angle.

6—X-RAY TRANSFORMER for energizing a 30 MA. 5-inch Radiator Type Coolidge Tube.

7—SEPARATE PORTABLE CONTROL STAND equipped with all necessary meters, switches, etc., together with a COOLIDGE TRANSFORMER and an AUTO TRANSFORMER which make any desired milliamperage and voltage available up to the capacity of the tube.

8—BOTH PUSH BUTTON AND FOOT SWITCH CONTROL.

Many other features are fully described in a bulletin we will send postpaid on request.

ACME X-RAY COMPANY 341-351 WEST CHICAGO AVE. CHICAGO, ILLINOIS, U. S. A.

The New Electro-Coagulation Method

The new Thompson-Plaster High Power Diathermic and D'Arsonval Apparatus with oil insulated transformer has been especially constructed for heavy Electro-Coagulation operations and supplies an extremely high sustained oscillatory current, from practically zero potential to 3,000 milliamperes. The Combination Treatment Cabinets have become very popular during the last few years to produce profound physiological results in conditions where an increase of temperature is desired, and in deep-seated inflammation to alleviate pain and relieve congestion.

Thompson-Plaster High Power Diathermic and Combination Treatment Cabinet with Oil Insulated Transformer. Contains SIXTEEN Modalities working independently. Write for our new book "Electro-Therapy in the Abstract and Electro-Coagulation." Sent without obligation.

THOMPSON-PLASTER X-RAY CO.
LEESBURG, VA.

F. WILSON ILLE, 126 EAST 28TH STREET, *Distributor for New York City*

WAPPLER

NUMBER
FIVE
BEDSIDE
AND
HOSPITAL
X-RAY UNIT

$825.00
Including Tube
and Shield
For 110 Volts, A. C.
F. O. B. - N. Y. C.

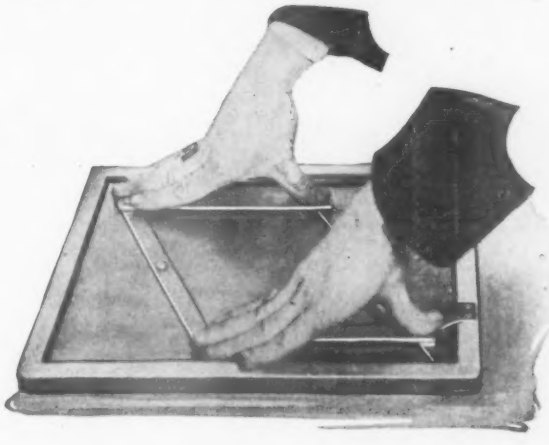
THE WAPPLER NUMBER FIVE BEDSIDE AND HOSPITAL X-RAY UNIT is an absolutely reliable and perfected apparatus. Its electrical design and operating features are fundamentally correct. It is as nearly automatic as an X-Ray machine with a variable back-up and milliamperage range can be. It is so constructed that practically every roentgenogram desired, including gastro-intestinal, can be made. Furthermore it is so designed that the regular Dental right-angle Coolidge tube can be used with it and the instrument instantly converted into a real Dental X-Ray machine. We suggest that you send immediately for Bulletin #96, and give your most careful consideration to the apparatus described therein.

WAPPLER ELECTRIC COMPANY, Inc.
LONG ISLAND CITY N. Y., U. S. A.

WAPPLER

TRADE KAYESS PRODUCTS MARK

The Key to Your Cassette Problem



Showing the Ease with which the Kayess Cassette is Opened and Closed

The patient's weight oftentimes causes a wood or part wood Cassette to warp, crack open at the corners or spring open at the cover—admitting the light and spoiling the screen. This causes the Roentgenologist ceaseless annoyance and a needless loss of time—when time is most valuable indeed.

The Kayess All-Aluminum Cassette

releases the Roentgenologist from this haunting fear. Its all-aluminum construction permits of a 300 pound pressure with no danger of warpage, cracking or springing, and seemingly wears forever.

Special prices on initial orders.
Write for the complete details.

The Kny-Scheerer Corporation of America

ELECTRO-MEDICAL DEPARTMENT

56-58 WEST 23RD ST. NEW YORK

Send me complete details on Kayess Cassettes
Name .....
Street .....
City .....
State .....
A. J. of R. Dec.

PNEUMOPERITONEUM

BY

DR. ARTHUR STEIN & DR. WILLIAM H. STEWART

NEW YORK CITY

The illustrated monograph on "PNEUMOPERITONEUM" now in preparation, will contain a complete historical review of the evolution of the new diagnostic method of air or gas inflation of the abdominal cavity, in combination with Roentgen examination. The authors, who after a careful study of its merits introduced this procedure in America, give a full description of their own technique and contribute a series of excellent Roentgenograms obtained by its employment. The new method, which is shown to be safe and painless when properly employed, is fully described, consisting of inflation of the abdomen with a mixture of different gases, a modification which will make it an office procedure and obviate the necessity for deflation after the Roentgen examination has been completed. The text is enriched by actual Roentgenograms of various abdominal organs in which all details of the plate are preserved, permitting a better interpretation of abdominal pathology, so that the progressive physician will find in this monograph not only a valuable source of information, but a practical adjuvant in the solution of diagnostic problems not amenable to any of the older methods of examination.

SOUTHWORTH COMPANY

PUBLISHERS TROY, NEW YORK

The "HOGAN" High Frequency Apparatus

THREE IN ONE

D'ARSONVAL SOLENOID
AFFORDING

Auto-Condensation, Diathermy, Electro-Coagulation, Dessication, Bipolar Technique

OUDIN RESONATOR
AFFORDING

Cool Unipolar High Frequency Currents under accurate control. Excellent for a wide range of treatments including fulguration.

TESLA COIL
AFFORDING

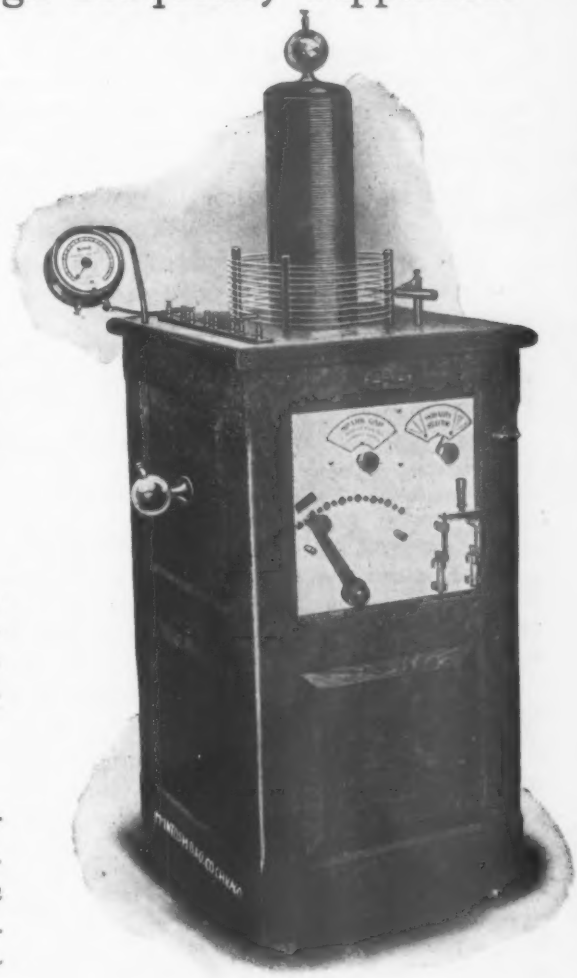
Hot Unipolar High Frequency Currents, which produce quickly a deep and lasting Hyperemia. May also be applied in bipolar way for general diathermy effects.

EQUIPPED WITH

Powerful High Tension Transformer Oil Insulated in sealed metal tank.

Improved Oil Immersed Franklin Plate Condenser in sealed metal tank.

McIntosh Staggered Non-Oxidizable Spark Gap.



THE "HOGAN"

"SIMTECH," *practical technique and special offer sent for a limited time only.*

MANUFACTURED BY

THE McINTOSH BATTERY & OPTICAL CO.

MAKERS OF

"HOGAN SILENT" X-Ray Transformers and Physical Therapy Apparatus

Main Office and Factory McINTOSH BUILDING

223-233 N. CALIFORNIA AVE., CHICAGO, ILL.

Eastern Service Station and Salesrooms:
405 LEXINGTON AVE., NEW YORK, N. Y.

McIntosh Battery & Optical Co., 223 N. California Ave., Chicago, Ill.
Gentlemen: Please send me "Simtech" and special offer on the "Hogan."
Name.....
Street.....
City.....
State.....
A. J. of R.

NEW APPARATUS

OIL-IMMERSED X-RAY UNIT is original with the Waite & Bartlett Manufacturing Co. The first Unit was installed for Dr. Preston Hickey, of Detroit, about two years ago, and is used by him every day for setting fractures. The same model is now being used by Dr. W. D. Witherbee, of New York City, for treating Tonsils. It makes an apparatus that is ABSOLUTELY safe from any possible chance of spark from HIGH VOLTAGE. The price of 110 volt A. C. $650.00. Delivery 3 weeks.

NEW SPHERE GAP FOR ACCURATE READING OF HIGH VOLTAGE. It has a REMOTE control and is a direct reading on LOW voltage switchboard. (Patent pending.) Delivery 8 weeks.

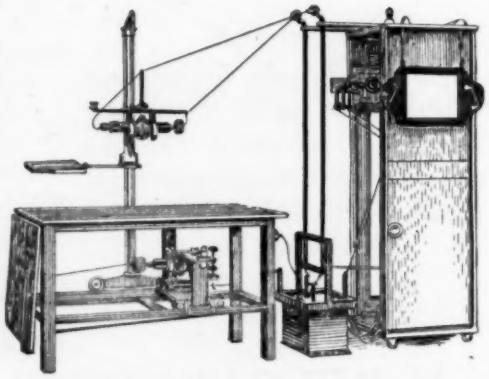
NEW SYNCHRONOUS MOTOR TREATMENT TIME SWITCH. No clock to forget to wind. Reset instantly. Treatment can be interrupted and yet cut off at time set. (Patent pending.) Price $75.00. With contactor $110.00. Delivery 4 weeks.

NEW VIBRATING POTTER-BUCKY DIAPHRAGM, Motor operated. It is FLAT. It is built without any dingle bells or flashlights to observe. Simply start motor and make exposure when you are ready. Price $200.00. With contactor $235.00. Delivery 8 weeks. (Patent pending.)

THE 20-in. SPARK INTERRUPTERLESS MACHINE that we are installing for the General Memorial Cancer Hospital, New York City, is a machine made especially for this work and not a combination of previously used parts. The TERMINAL of the filament transformer also acts as one of the PRIME COLLECTORS. 1-½-in. brass tubing runs directly from the prime collectors of the machine to the terminals of the X-Ray Tube. The tube box is lined with ¼-in. thick METALLIC LEAD. The table top is made of wood with proper insulation and mounted on a pedestal that is adjustable for height and angles. There is an ACCURATE overload circuit breaker. To Operate: The lead-lined tube box MUST be closed. Operator MUST keep hand on operating switch. If anyone comes within a certain distance of machine when operating it INSTANTLY stops; the operator has to reset protective device.

INVESTIGATE the X-RAY and electrical PROTECTION afforded operator, patient and assistants before buying a 20-in. Spark Machine.

The CAREFUL buyer is our customer, because he considers the reputation of the manufacturer as well as the apparatus. 42 YEARS in business and at the SAME bank, assure you of our reliability and responsibility. The apparatus speaks for itself, SIMPLE, ACCESSIBLE, and so free from complications that we guarantee ANY electrician can install it. An apparatus which is so COMPLICATED that it is necessary to have a SPECIALLY trained expert to install it is sure to REQUIRE a service man to keep it going. Corporations exploiting the SERVICE man will tell you that it cannot be done. Well, we are doing it EVERY day. We have many other new devices and will be glad to answer any communication.



Suitable for Small Hospitals

WAITE & BARTLETT MFG. CO.

Factory and Main Office

53 JACKSON AVENUE LONG ISLAND CITY

New York Office, 103 PARK AVENUE, NEW YORK CITY

Austin, Texas (Oliver Brush) 708 Colorado St. - *Boston, Mass.* (Clapp Anderson Co.) 18 Boylston Place

Los Angeles, Cal. (X-Ray Supply Corp.) 127 East 6th Street

EIGHT MEN TRAVELING IN AND OUT OF PHILADELPHIA

Represent the house of

M. H. BRESETTE COMPANY

These men are trained to render the very highest type of service to the Roentgenologist.

Each man a specialist in some one branch, in the aggregate they are probably the most competent staff of men with any X-Ray house to-day.

Your problems are safe in their hands.

They will at all times cheerfully assist you in the design of a laboratory, equip it with the best apparatus the market affords, install same in a scientific manner and keep it in operation.

No matter where you are in the East, or what your X-Ray troubles may be, some one of these men is within a few hours journey, ready and willing to serve.

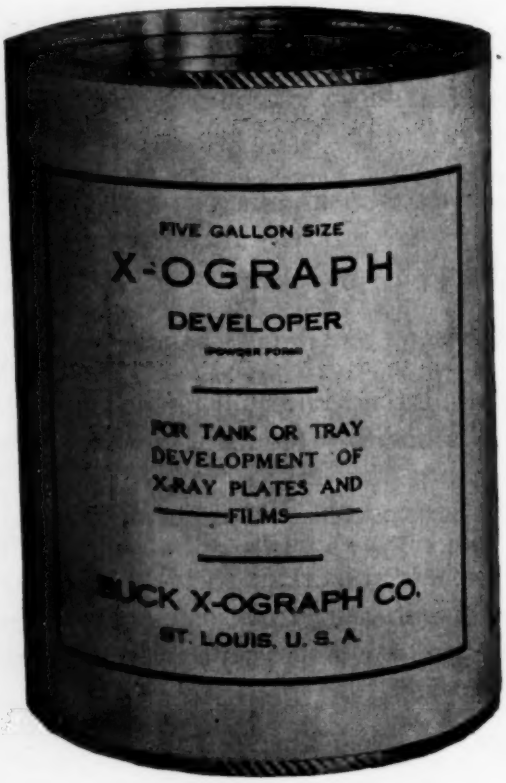
We sell and repair everything for the X-Ray Laboratory; write us for quotations on your needs.

M. H. BRESETTE COMPANY

25 South Seventeenth St. Philadelphia, Pa.

X-OGRAPH DEVELOPING POWDER

FIVE GALLON SIZE



PRICE $5.00

WHY take the risk of error and lack of uniformity, coincident to preparing your own developing solution, when it is possible to purchase a high grade and accurately compounded developer at the rate of $1.00 per gallon?

Same developer as contained in our smaller sized packages.

BUCK X-OGRAPH COMPANY

6629-31 OLIVE ST. RD. ST. LOUIS, MO.

Wholesale *Import* *Retail*

GEHLER·FOLIE

(GUARANTEED GENUINE)

INTENSIFYING SCREENS

GEHLER FOLIES
have been known to the Profession
for over ten years

Used and insisted upon by the
oldest Roentgenologists

HIGHER in SPEED

ABSOLUTELY NO GRAIN

LONGEST LIFE
because hard surface

The "SUPERIOR" Intensifying Screen
for Plate-work with one Screen,
or Double-Screen-work with
Duplitized Films

Ask the Expert Roentgenologist.

Order from your SUPPLY HOUSE,
or direct
from the General-Agency

JNO. V. DOEHREN CO.

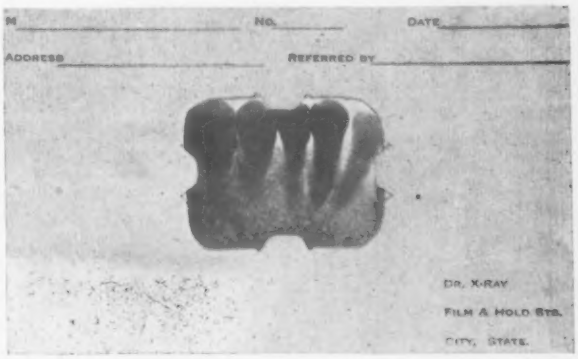
208 NO. WABASH AVE. CHICAGO, U.S.A.

Everything for the Roentgen Laboratory

"PHILMHOLD"

A NEW AND MODERN FILM MOUNT

(ACTUAL SIZE 3" x 5")



PRACTICAL - NEAT - INEXPENSIVE

A most convenient means for filing your dental films in almost any filing cabinet.

Prices quoted on application
Special prices to dealers

We carry a Complete line of all X-Ray accessories—

FILMS - PLATES - CHEMICALS
SCREENS - CASSETTES - etc. etc.
of standard makes

OUR
SERVICE IS "PAR EXCELLENCE"

X-RAY FILM & CHEMICAL CO.
INCORPORATED
257 COLUMBUS AVE., NEW YORK CITY
PHONE COLUMBUS 6743

Neol-HAUFF

THE NEW X-RAY DEVELOPER

DESTROYS HALATION - - EQUALIZES EXPOSURE

The best X-Ray Tank Developer

HAUFF'S ROENTGEN PLATES

Rapid with or without Screen - - - Snappy and Brilliant

5 x 7	Per Dozen		$1.45	10 x 12	Per Dozen		$ 5.60
6½ x 8½	"	"	2.20	11 x 14	"	"	8.00
8 x 10	"	"	3.20	14 x 17	"	"	13.75

Sold by all dealers at above low prices.

G. GENNERT

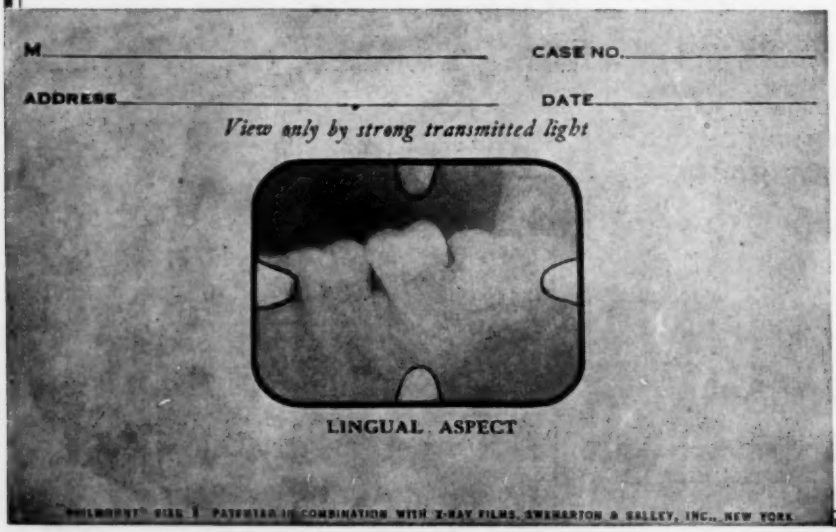
NEW YORK CHICAGO LOS ANGELES SEATTLE

Trade "Philmounts" Mark

Patented in Combination with X-Ray Films

Hold the Film—*They Don't Jump Out*

Increase the Detail of Film (Picture)
Eliminate Foreign Objects when Viewing
A Protection to Emulsion Side of Film
A Convenient Holder when Viewing
A Means of Filing and Recording
An Advertisement for You



40 Stock Sizes
1 to 14 Films on
Special Sizes to Order

Send for New Catalog and Price List

Any sale or use of our patented combination is an infringement and notice is given to the trade that not only will infringers be prosecuted as aforesaid, but a demand will be made, in any litigation against users, that all infringing combinations of films and mounts be delivered up for destruction.

SWENARTON & SALLEY, Inc.
350 W. 38th St., New York

" " *"Best by Test—Regardless of Price"* " "

ROENTGENOLOGISTS—ATTENTION!

Save Money on Your X-Ray Screens

THIS IS THE FRENCH SCREEN, made by CAPLAIN ST. ANDRE FILS & CIE., of Paris, and used in our Army laboratories overseas. They are superior in *speed, detail* and *economy* to any American Screen. Used and endorsed by leading roentgenologists. Save 50% and procure a superior Screen. Immediate delivery, packed in original portfolios; every Screen tested and guaranteed perfect.

Can be furnished *washable*, delivery one month.

Single		Size		Double
$10.00	-	8 x 10	-	$20.00
15.00	-	10 x 12	-	30.00
22.00	-	11 x 14	-	44.00
30.00	-	14 x 17	-	60.00

Terms: Net, C.O.D., f.o.b. Detroit, or 5 per cent disc. check with order.
Reference: Wayne County & Home Savings Bank, Detroit.

THE FRENCH SCREEN COMPANY

406 MCKERCHEY BLDG. - 2631 WOODWARD AVE. - DETROIT, MICH.

Measure
Your Filament Current with

Weston

MODEL 156 OR 261
AMMETERS

and eliminate all possibility of obtaining unsatisfactory results from your Coolidge Tubes.

These Instruments possess every essential characteristic to enable them to render dependable service under the most exacting conditions.

Model 156 has a diameter of 7¼ inches, and Model 261 9⅝ inches.

We invite your consideration of these and other WESTON INSTRUMENTS for X-Ray purposes.

WESTON ELECTRICAL INSTRUMENT COMPANY

160 WESTON AVE. (*Offices in all principal cities*) NEWARK, N. J.

Better than Buttermilk

AS X-RAY MEAL

THE ORIGINAL

"Horlick's" palatability overcomes the chief drawback to the use of buttermilk.

Its motility equals buttermilk, and studies may be begun almost immediately after ingestion.

The Original can be given at body temperature and so present viscera in the natural condition. "Horlick's" is also more convenient to prepare and keep.

For samples and literature write

HORLICK'S - RACINE, WIS.

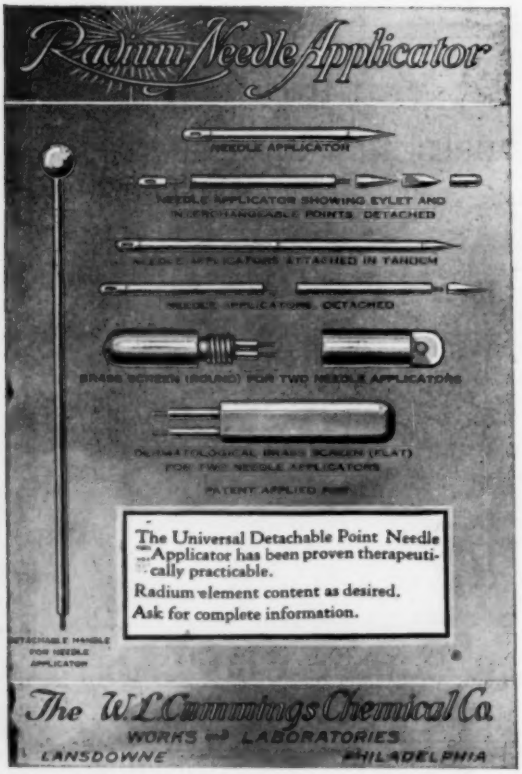
LARGEST STOCK OF X-RAY PLATES AND FILMS WEST OF CHICAGO

"Everything for the Roentgenologist"

WESTERN ROENTGENOLOGISTS will find it to their advantage to deal with a WESTERN HOUSE

MAGNUSON X-RAY CO.

DENVER - - - 1510 Court Place
OMAHA - - - 1118 Farnam Street
KANSAS CITY - - 1006 Oak Street
DES MOINES - - 571 Seventh Street


Radium Needle Applicator
NEEDLE APPLICATOR
NEEDLE APPLICATOR SHOWING EYLET AND INTERCHANGEABLE POINTS DETACHED
NEEDLE APPLICATORS ATTACHED IN TANDEM
NEEDLE APPLICATORS DETACHED
BRASS SCREEN (ROUND) FOR TWO NEEDLE APPLICATORS
OPHTHALMOLOGICAL BRASS SCREEN (FLAT) FOR TWO NEEDLE APPLICATORS
PATENT APPLIED FOR
The Universal Detachable Point Needle Applicator has been proven therapeutically practicable.
Radium element content as desired.
Ask for complete information.
DETACHABLE HANDLE FOR NEEDLE APPLICATOR
The W. L. Cummings Chemical Co.
WORKS and LABORATORIES
LANSDOWNE PHILADELPHIA

F. BLUME X-RAY SCREEN COMPANY

6423 IRVING PARK BOULEVARD, CHICAGO, ILL.

Manufacturers of

Fluoroscopes and Fluoroscopic Screens

NEW—BETTER
MORE EFFICIENT
REASONABLE

A green or steel blue Screen. No Emulsion to peel off; no dampness or bombardment by X-Rays can hurt it. On Cardboard or Alloy.

U. S. and Foreign Dealers also Wanted.

"X-Ray Supplies. All the name implies"

EASTERN AGENTS FOR

POTTER-BUCKY DIAPHRAGM

For clear Shadows of Spine, Sacrum, Coccyx, both Kidneys and often the Pathological Gallbladder all on one 14 x 17 film and with a wealth of detail hitherto unobtainable even on smaller plates.

MIDDLE STATES AGENTS

SWEETBRIAR

INTENSIFYING SCREENS

(Both Standard and Thin)

Grainless - Fast - Washable

"THEY CATCH NO DIRT"

Lessen your Screen expense. Take advantage of our Special Introductory Cash Discount 30% on THIN Screens—when combinations are ordered.

X-Ray Tubes - Repaired & Rebuilt

You always get WHAT *you want* WHEN *you need it*

FROM

AMERICAN VACUUM CO.

1011 CHESTNUT ST. PHILADELPHIA

THE ROENTGENOLOGISTS' EXCHANGE COLUMN

Classified advertisements of roentgenologists desiring assistants, roentgenologists seeking new locations, technicians desiring positions, apparatus and furniture for sale or wanted. First 50 words or less, $2.50. Additional words, 5 cents each.

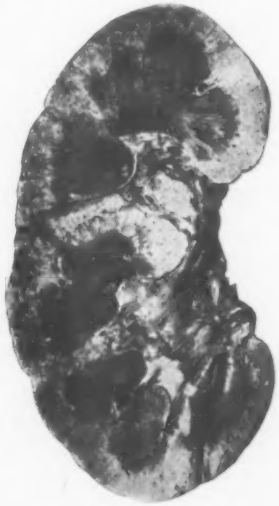
FOR SALE

ETHICAL *X*-RAY LABORATORY and good practice in a large city in Minnesota, by a recognized Technician. Practice can be greatly increased by treatment and diagnosis. Victor machine with combination table, stereoscope, Coolidge and gas tubes, Bucky diaphragm, treatment cones, Victor dental tube stand and chair, office furniture and fixtures. Inventories $5000.00. Sale reasons, other interests. $3000.00 cash. Address Minnesota, care The American Journal of Roentgenology.

WANTED

POSITION WITH HOSPITAL by highly qualified roentgenologist, M.D. Address W., care The American Journal of Roentgenology.

PHOTOGRAPHS OF PATHOLOGICAL SPECIMENS



CONFIRM YOUR X-RAY DIAGNOSIS BY SHOWING THE PATHOLOGICAL FINDINGS

S. W. NOURSE

PHONE CLIFFSIDE 331 PALISADE, N. J.

INJURIES & DISEASES OF THE BONES AND JOINTS

By FREDERICK H. BAETJER, M.D.

and CHARLES A. WATERS, M.D.

"The outstanding features of this work are its thoroughly practical character, and the intimate and accurate views on the problems of medicine and surgery and of the morbid anatomy in each field of study. Fractures, dislocations, joint lesions, bone infections, bone tumors, various abnormalities and dystrophies are considered from every angle of diagnosis."—

Johns Hopkins Hosp. Bull.

LARGE OCTAVO - CLOTH - 350 PAGES

332 ROENTGENOGRAMS - PRICE $10.00 *net*

PAUL B. HOEBER, *Publisher*

67-69 E. 59TH ST. NEW YORK CITY

THE POTTER-BUCKY DIAPHRAGM

A NECESSITY IN EVERY X-RAY LABORATORY

The greatest Aid to Fine Radiography ever produced

Prevents most secondary radiation from the patient's body reaching the plate insuring marvelous detail in all heavy parts, especially valuable on Head, Pelvis, Spine, Kidney or Gall-Bladder work. Can be used on any X-Ray table. Takes all size plates or films to 14 x 17, either position. Adjustable for exposures from ½ second to 2 minutes. Not an experiment but a practical apparatus, now being used by many prominent roentgenologists.

The best practical portable ever devised uses special type lead glass Coolidge Tube—10 milliamp—5 inch spark gap. Has Auto Transformer, 30 second time switch—milliamp meter—stereoscopic tube stand—automatic safety device and volt meter. Weight complete 123 lbs. With double intensifying screens will do stomach radiographs in 1½ to 3 seconds. Chest ½ second, hips 2½ seconds, frontal sinus 4 seconds, etc. Can be operated from any electric light.

Price delivered and installed { 110 volt Alternating Current - $850.00
110 volt Direct Current - $960.00

Every one knows of the fine quality and high speed of the pre-war PARAGON PLATES. We are furnishing them again at pre-war discounts. Get our discount on case lots, delivered Freight Paid. Sure to please you. A trial convinces.

We carry a large stock of all X-Ray Supplies including Duplitized Films, Plates, Intensifying Screens, Developer, Dental Film Mounts, Developing Tanks, Coolidge Tubes, etc. Get our price list before buying. Prompt shipment, always.

GEO. W. BRADY & CO.

761 S. WESTERN AVE. CHICAGO, ILL.

REDUCTION IN PRICES

ON REGULAR

EASTMAN DUPLITIZED FILMS

IN EFFECT NOVEMBER 15, 1921

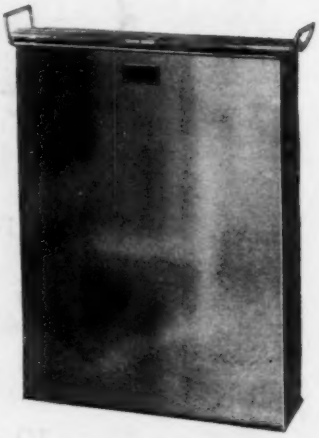
We pay War Tax	Net Price
14 x 17	$7.64
11 x 14	5.02
10 x 12	3.96
8 x 10	2.51
6½ x 8½	1.75
5 x 7	1.10

PLUS the usual PICKER SERVICE

JAMES PICKER
686 Lexington Ave.
New York City

Announcing

Eastman X-Ray Tank



This convenient tank unit will be of material aid in standardizing development—made of monel metal it is impervious to the action of either developer or fixer—is unbreakable and of light weight.

Dimensions 4½ x 15½ x 20 inches.
Capacity about 5½ gallons.

Price $15

Eastman X-Ray Illuminator

This viewing unit fills, we believe, a long-felt want. Light is furnished by a single lamp (100-watt frosted bowl daylight Mazda is suggested) yet illumination is ample and is evenly diffused by flashed opal glass.

Clips are provided for holding films. Designed so that units will fit snugly together, side by side.

Mahogany finish only.

Price $16.50

Eastman Kodak Company

Medical Division — Rochester, N. Y.